

The Iron Age

A Review of the Hardware and Metal Trades.

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Vertical Blowing Engine.

We publish herewith four interesting illustrations of a vertical direct-acting blowing engine, built by Mr. Henry G. Morris, of the Southwark Foundry, Philadelphia. The blowing cylinder is 84 in. in diameter, with 4 ft. stroke, and is mounted on four inclined cast iron columns, which take the place of the side frame, more usually adopted here. As will be seen from the side elevation, the columns are connected by castings forming the crosshead guides. The steam cylinder is 44 in. in diameter, and of course of the same stroke as the blowing cylinder. It is mounted on a base which spans the crankshaft as shown, and has no other connection with the framing. The engine is fitted with steam and exhaust valves of the

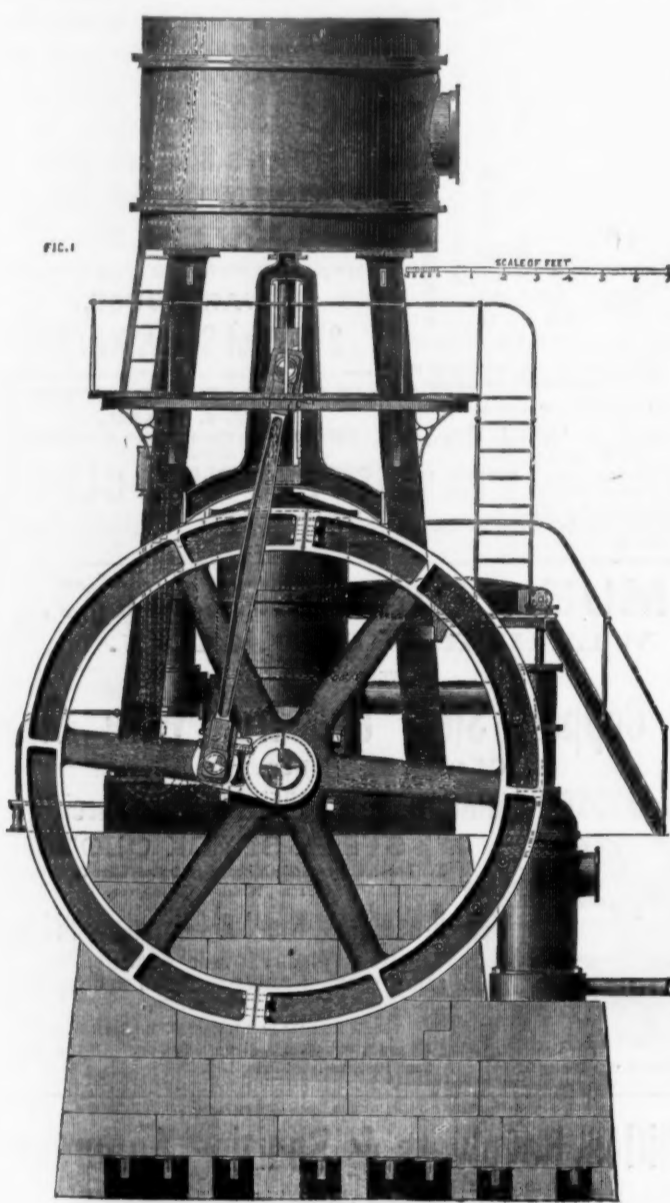
The Bessemer Channel Steamer.

The (London) *Standard* supplies the following description of the new Bessemer channel steamer now being built at Earle's shipbuilding yard at Hull, and which it is expected will leave the stocks in about a month for her trial trip between Dover and Calais. The steamer claims more than ordinary attention as an experiment which is shortly to be made of diminishing the discomforts to passengers that usually attend a passage across the Channel. Her length is 350 feet, and she has a width of 40 feet along the deck beam and 65 feet across the paddle boxes. To the uninitiated observer she presents the appearance of a turret ship, having her ends low for the purpose of reducing the motion produced by the action of the wind and sea, while

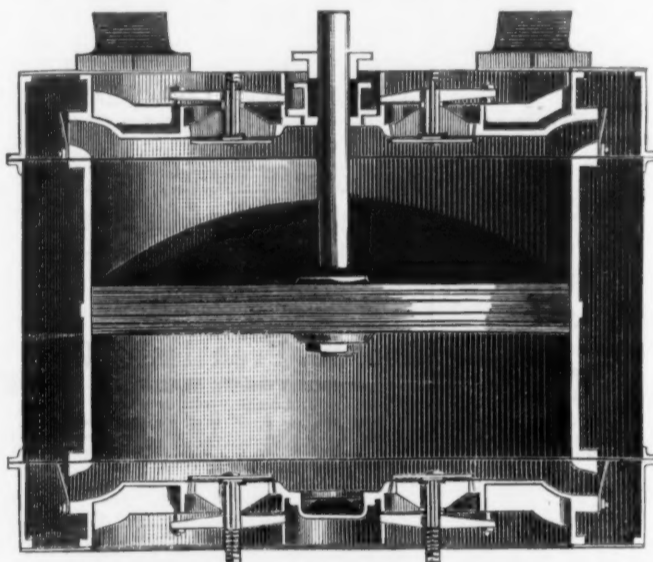
is 70 feet long, 35 feet wide, and 20 feet high, and accommodation will also be provided for passengers in a fixed cabin 52 feet long at one end, between decks, and a line of small cabins on each side of the ship, between the paddle boxes. There will also be a refreshment saloon, smoking cabin, lavatories, and small deck cabins; in fact every conceivable convenience and comfort is provided for those who undertake a journey by these means. As originally designed, we understand it was not intended to call into requisition any aid to the four enormous paddle wheels by which the vessel will be propelled; but very recently it has been decided to fix a light mast with sails at either end, which will tend to improve the appearance of the steamer, and probably assist in securing that passivity among the channel waves which

duce to steadiness, and, in addition, she will have bilge pieces, three feet wide, and nearly 100 feet long, placed between the two paddle wheels on either side. Thus, to all intents and purposes, she will be a large vessel floating in comparatively small waves, with all the motions reduced by special features in the design, and, so far as the saloon is concerned, the rolling and pitching motion practically annihilated, or very nearly so. To say the least, the substitution of vessels of this type for the present ones will be a boon for which many travelers will be truly thankful, and we have not the smallest doubt that when her capabilities are tested she will be found to answer in every point the expectations of those by whom she was designed. There is little doubt now that the vessel will be completed within the month specified, and, as she

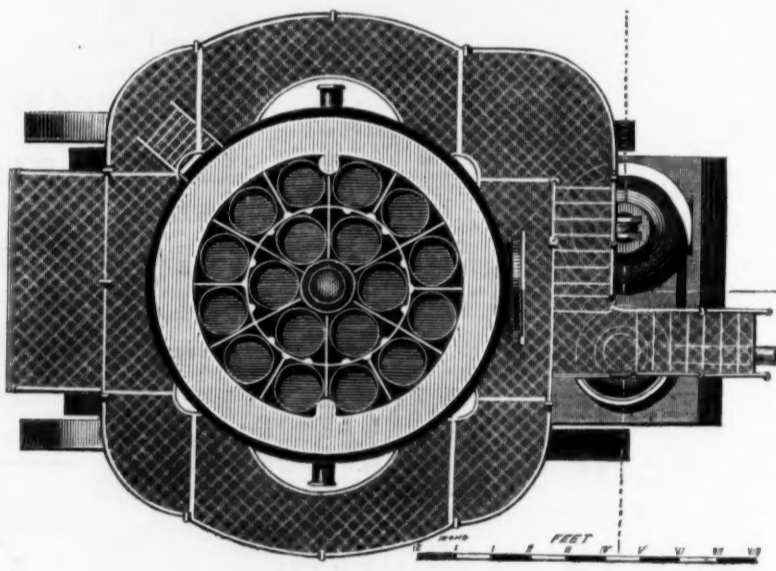
and Ohio, the Pennsylvania Railroad, and New York Central. To enable the East to throw off their yoke, the Hoosac Tunnel had been constructed, and now Commodore Vanderbilt had tried, in collusion with the President of the Boston and Albany, to purchase it from the State, offering \$8,000,000 for the purpose of plugging it up." With the tunnel under the control of the State, "the people of Boston," we are further told, "would pay \$1.50 per ton less for coal and \$1 as dividends on railroad stock by reason of reduced freights, where now they pay \$3." These grievances may or may not be well founded, but what will the proposed remedy cost the people of Boston especially, and the balance of the State, before they get through with it? One Credit Mobilier scandal should be enough,



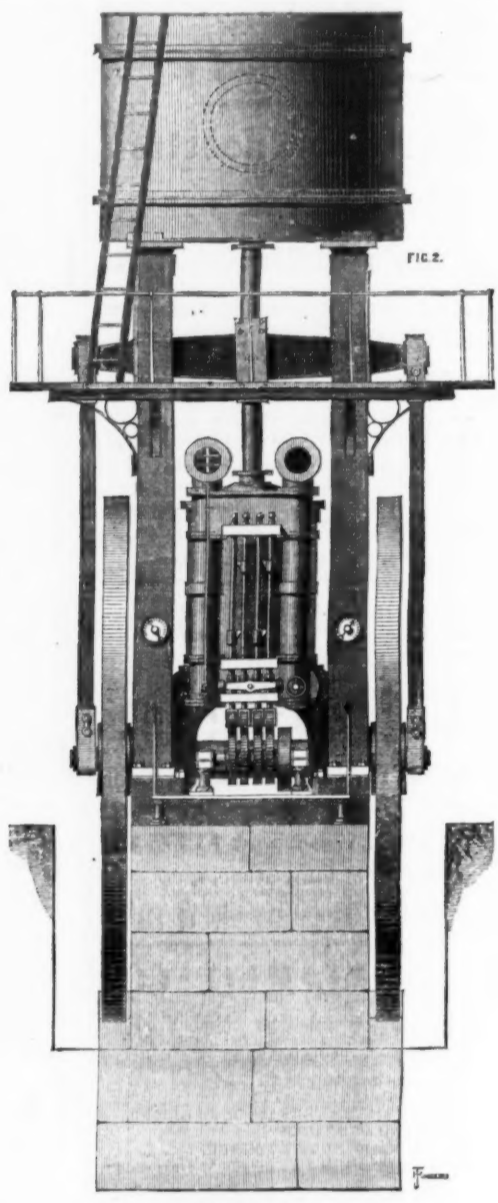
Side Elevation.



Section of Blowing Cylinder.



Plan of Delivery Valves.



End Elevation.

VERTICAL BLOWING ENGINES, BUILT AT THE SOUTHWARK FOUNDRY, PHILADELPHIA.

equilibrium type, these valves being worked by cams fixed in a cam-shaft, which is driven from the fly-wheel shaft by a pair of spur wheels.

The fly-wheels are 16 ft. in diameter, and are overhung as shown, each being furnished with a crank pin from which a connecting rod extends to the long crosshead working between the two cylinders. Each wheel is cast in two pieces. The engine is fitted with a jet condenser, and an air pump situated at the back, as shown in the side elevation, the air pump being driven from the main crosshead through the intervention of links and unequal armed beams.

The valves of the blowing cylinder are arranged as shown in the enlarged section. The delivery valves are, as will be seen, ordinary flap valves arranged around the cylinder barrel at the top and bottom, and opening into a wrought iron casing by which the cylinder is surrounded. The suction valves are round disc valves fitted to the cylinder covers, each valve being fitted to a loose seat coned externally to fit a corresponding opening in the cover, and held in place by a crossbar and bolt, as shown. The suction valves of the upper cover are closed by light spiral springs placed on their central spindles. The engine is intended for being run at a speed of 50 revolutions per minute, corresponding to a piston speed of 400 ft. per minute, and it will no doubt do good work.

Ainall & Cochran, founders, Louisville, have taken the contract for the iron work for the inclined railway at Cincinnati.

The middle portion is sufficiently high to enable her to steam at a great speed against the worst seas she will have to meet. The main portion of the vessel is 232 feet long, and the low ends are each 45 feet in length, but in case of the water rushing over these, the ends of the upper deck are constructed like the prow of an ordinary vessel, and are thus adapted for clearing the water and throwing it on one side. Being nearly flat bottomed, and drawing only 7 feet 6 inches of water, she will be propelled by her two sets of paddle wheels at a speed of 20 miles an hour, whilst her light draught will enable her to enter the shallow French harbors, which would be inaccessible to vessels of greater depth. Moreover, the provision of a rudder at each end, with means for locking, will enable the ship to be steamed in either direction, and obviate the necessity for turning in harbor. The peculiar feature of the vessel, however, and upon the result of which so much depends, is the saloon, designed by Mr. Bessemer, of Denmark-hill, London, the object of which is to lessen, if not altogether to remove, the inconvenience at present suffered by voyagers. This saloon is suspended in the middle of the ship in such a way that it can be moved about a longitudinal axis parallel to the keel. The motion of this saloon, which would be set up if left free to move, will be governed by a hydraulic apparatus, and will be completely under the control of one man, whose duty it will be to keep the floor of the saloon, under all circumstances, in line with a spirit level. The Bessemer saloon

is the chief aim of the designers. Speaking of this great essential quality of the vessel, namely the avoidance of the pitching and rolling motions which are the principal causes of sea sickness, we are bound to admit that, so far as we can at present discern, the promoters of this scheme have succeeded to a nicety. The saloon is in the middle of the ship, as regards length and breadth, and the axis of rotation is at a height where there is the least motion; so that with reference to its position it is one in which the vertical and lateral motions produced in every part of the ship by the pitching and rolling will be so small as to be inappreciable. It is contended, in reply to certain objectors, that the onward motion of a vessel has little or no effect, so far as sickness is concerned; for though in railway traveling the speed is considerably greater, yet causes of inconvenience in that respect are the exception, and not the rule. The great height and size of the saloon will enable it to be completely ventilated, and it will be unnecessary for ladies and delicate persons to remain in the worst weather on deck rather than accept shelter in it. Independently of the perfect level of the saloon, the thorough ventilation and the avoidance of vibratory motion, the size and form of this steamer and the great powers of resistance to rolling she possesses will ensure her the utmost steadiness among the seas peculiar to that part of the channel which she is intended to cross. The resistance her paddle-wheels offer to rolling, and the great speed at which she will be driven, will all con-

will be fitted with engines and machinery before the launch, she will make clear away for her trial trip directly she leaves the yard.

Railroad Legislation.

The Bay State Transportation League held its first public meeting in Boston on the 8th inst., at which its declaration of principles and its practical objects were announced to the public. The hope was expressed that "the issue of the coming election might be so far controlled that the balance of power favorable to the League would be had in the next Legislature." With this degree of success, it is expected that "State ownership of the Hoosac Tunnel may be secured beyond a doubt, and eventually an independent line of railroad opened to connect Boston with Lake Ontario." Speeches were made in which the claims of Boston to superior business advantages over Baltimore, Philadelphia and New York were based upon a "nearer air-line to Liverpool and other great commercial centers of Europe," beside, "direct entry to and egress from port, which those cities do not offer." [This may be all true, but the history of commerce will show that something beside "air lines" are necessary to attract and hold it.] In the next place, managers of railroads are denounced upon general principles. By the concentrated power of these magnates we are told the people are taxed without representation, and that tax extorted from the East by the controlling spirits of the Baltimore

unless there are parties in our sister city emulous of the profits and reputation of which such things are productive.

If the League shall have any strength, the next movement doubtless will be a counter one on the part of the railroads, and in this way the Massachusetts State House is in a fair way to become an arena quite as scandalous in its contentions between rival railway schemes and schemers as was the New York Legislature under the old-time "Albany regency."

The singular spectacle is now presented of a powerful farmers' movement at the Northwest to control the railroads through the machinery of State legislation, and, on the other hand, a railroad movement at the East to control competing interests by something of the same process. Where all this is going to end, we must wait and see. The invocation of politicians by business men, as if to advance one set of interests to the prejudice of another set, will probably not be a profitable speculation in its ultimate results. Like the fabled invocation of Frankenstein, the monster no doubt will respond; but as soon as he feels his own strength, will it not be only to crush his creator to atoms?

The annual meeting of the stockholders of the Thomas Iron Company was held at Hoken-daqua on Tuesday last, and the following board of directors elected: David Thomas, Benjamin G. Clark, Samuel Thomas, Wm. W. Marsh, John T. Knight, Charles Stewart, Daniel Runkle.

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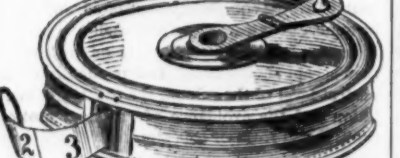
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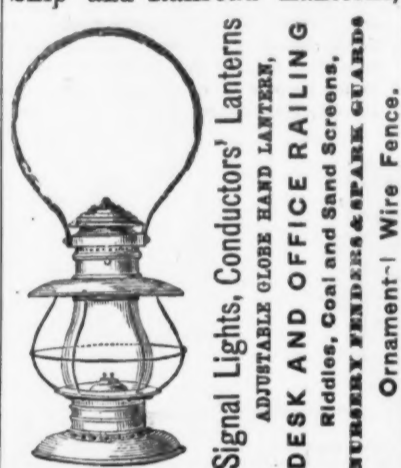
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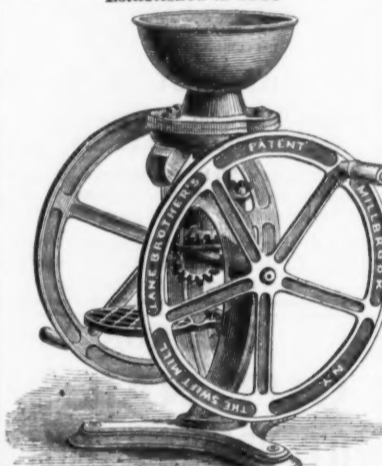


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The Ives Lamp—Self-Extinguishing Lamps—Self-Lighting Lamps.

III.

The oldest safety lamp now in the market is

THE IVES' PATENT LAMP,

for which not only safety is claimed, but durability and cleanliness. The first advantage is attained by completely separating the flame from the gas formed in the lamp. The cap of the lamp to which the burner is fixed is formed of copper, and a wide tube is attached thereto which extends down into the lamp. The bottom of the tube is below the center of the reservoir. The level of the oil should always be above the bottom of the tube. When this is the case the space in the reservoir above the surface of the oil is divided into two portions—that within the tube, and the portion between the tube and the glass exterior of the reservoir. The gas which forms over the surface of the oil cannot, of course, gain access to the air tube so long as the level of the oil is above the level of the bottom of the tube. If any excess of gas forms in the gas space, or gas chamber, as it is called, it is allowed to escape through minute perforations in the copper cap. An arrangement is provided in the burner, along side of the wick tube, for filling the lamp. No explosion can occur, as the oil itself completely shuts off communication between the air and the gas.

Durability is claimed for these lamps, because the reservoirs are made of heavy glass, and the chimneys of heavy flint glass. The manufacturers claim that the B burner will give a light equal to 15 candles. The lamp is manufactured by the Ives Patent Lamp Co., 41 Barclay street.

Under the head of non-explosibility should be considered also

THE PATENT MECHANICAL AIR LAMP,

which has the additional advantage of burning without a chimney. The base of the lamp is hollow and contains a clock work arrangement, which drives a little fan by which a current of air is propelled up through a tube to the base of the flame. The light produced is very white and brilliant. Inasmuch as a current of cold air is constantly being propelled through the oil, the latter always preserves the same temperature as the outside air, and no gas can be formed. The makers claim that the lamp is therefore non-explosive. The clock-work is wound up by a key and runs five hours. The lamp is sold by the Patent Mechanical Lamp Co., 138 Chambers street.

A peculiar

SELF EXTINGUISHING LAMP

is manufactured by Messrs. Smith & Rhind, of No. 40 Cortlandt street. It is non-explosive from careless handling, because when it is tipped over or used in any improper manner it immediately goes out. The burner is made with a pair of extinguishers, which may close together and put out the flame. The two wings or extinguishers are pivoted as levers, and at their lower extremities are connected by a spring in such a manner that when the spring is pressed the extinguishers are open, and when the pressure is removed they close again. The lower part of the spring bears against a ring, and the ring is sustained by a brass rod, which passes around the bowl of the lamp to the standard. The standard is made hollow, so that the rod can pass down through it. At the bottom the rod has a broad flat plate or foot secured to its lower end, which, when pressed upward, fits snugly into a conical recess formed in the under side of the foot, but which, when left free, projects down below the standard. When the lamp is standing on a table, or other flat surface, its weight keeps the rod pressed up, and the extinguishers open, but if the lamp falls over the foot of the rod is released, and the rod goes down, closing the extinguishers. But, in order that the light may not be extinguished every time the lamp is lifted up, the following device is employed. Just at the base of the bowl, and where the rod curves outward, so as to extend up the side of the bowl, the rod is bent so as to form a projection, up against which the hand presses in taking hold of the lamp to move it from place to place. The weight of the lamp pressing down keeps the upper end of the rod pressed up against the spring, and therefore the extinguishers remain open. But in case the hand grasps the standard, so as not to press up against the bowl, the extinguishing of the light is provided against in the following manner: A spring is secured to the side of the standard, its upper end being bent so as to extend more or less through the standard and catch in the notch or projection in the rod, before described, and thus to hold it locked in position. When one, therefore, grasps the standard he necessarily presses the spring in and locks the rod controlling the extinguishers. If one attempts to unscrew the burner, while lighted, he frees the spring from the pressure and the light goes out.

The extinguishers are made sufficiently wide that when pressed back from over the wick they strike against the top of the burner, and break the current of air which rises up along the edge of the frame, and prevents it from spreading. The inventor claims, therefore, that his device not only extinguishes the light, when necessary, but actually spreads the flame. In a later improvement the rod which connects with the extinguishers, instead of passing around the reservoir passes through the fount through a tube blown in glass when the fount is made. The very opposite of a self-extinguishing lamp is one that is self-lighting, and such a lamp has, in fact, been lately placed in the market.

THE SELF-LIGHTING KEROSENE LAMP

is sold by the Universal Self-Lighting Lamp and Gas Company, 563 Broadway. The invention consists in an attachment to the ordinary sun burner. On one side of the wick tube, that side opposite to the one to which the wick

elevator is applied, there is fixed to the wick tube, vertically at its middle, a small tube intended to support a fuse. This is called the fuse carrier. To the upper part of this tube a lever called the discharger is pivoted. The discharger is placed alongside of the fuse tube, and at its foot it is jointed to a short link or connecting rod extending from the lever to the bell crank of a shaft operated by a button at its outer end. Said shaft is perpendicular to that of the wick elevator. At its inner end the shaft carries a small tooth, which, during each revolution of the shaft, is carried into and out of an opening in the fuse which has a ratchet edge. When the button is turned around the shaft is caused to revolve and the tooth is made to act on the fuse, raising it in the tube, and at the same time the revolution of the shaft causes the discharger to be moved against and across the upper part of the fuse, so as to effect its ignition. From the burning fuse the wick is lighted. The fuse may be a band of pyroxyline, or some substance easily inflammable, and provided on one side with a strip or layer of match composition easily fired by friction. The fuse so made should fit closely in the fuse carrier.

Co-operative Mining.—A Birmingham

paper publishes the following particulars relative to the new colliery which the North Staffordshire Miners and the West Yorkshire Co-operative Mining Association intend to work: The new colliery is called the Harwood Colliery, and is situated at Halmerend, near Newcastle-under-Lyme. The freehold was the property of Messrs. Procter & Burgers. The new society has purchased Mr. Procter's share, which is 6 20ths of the freehold, for the sum of £13,000, £500 having already been paid down on account of the purchase money. The royalty payable to the holder of the remaining shares in the freehold, it is calculated, will be about £1000 per year. The West Yorkshire Association are prepared to pay the whole of the purchase money, if required. Two shafts are already sunk down, and to recover the costs it will require a working capital of about £2500, which the North Staffordshire Society are now fast accumulating. The colliery adjoins the celebrated Podmore Hall Colliery, the property of Messrs. Cooper & Craig, and which is worth over £200,000, and at which an enormous amount of money has been made during the past year by the proprietors. The new estate consists of about 14 acres. It is calculated that in no case will the cost of getting and placing the coal into trucks exceed half of the selling price. One gentleman is sanguine that a profit of 30 per cent. may be easily made out of the new venture. The working plant already on the ground is estimated to be worth from £4000 to £5000. Shafts are already sunk down to a depth of 120 yards to the Ragman and other first-class coals, which are no less than 15 ft. thick at this stage, and there are nearly 14 acres yet unworked. Thirty yards below them is another seam of coal 10 ft. thick. Sixteen yards below the 10 ft. seam exist the celebrated 2-row coals, 4 ft. in thickness each. Forty yards lower the 7 ft. Bambury coal is found of excellent quality. Twenty-four yards from the 7 ft. Bambury is found the 8 ft. thick. Fifty yards lower down still the famous Bullburst coal is recovered. Other seams of less importance are found under these. Railway communication exists within 1/4 mile of the colliery. Consequently the pit might be easily joined by a branch at a little expense. Shares in the new society, which is named "The West Yorkshire and North Staffordshire Co-operative Mining and Building Society (Limited)," are being taken up with great spirit by the various miners' lodges in connection with the North Staffordshire district. A great number of private shares have also been allotted.

Coal Mining in Russia.—The Azoff ports

in Russia have the prospect of a good trade before them, for the coal which underlies the Steppe along the northern shores of the Azoff, and which is now being largely explored. It appears that the existence of soft coal in Russia was ascertained some years ago, and an inferior kind of bituminous coal was extracted and conveyed to the different towns by the peasants. Not until about three years ago, however, was serious attention given to the subject, when careful examinations were made with the result that extensive seams of superior steam coal, coking coal and household coal were found to underlie the surface in the neighborhood of Mariopol. Indications of similar coal have also been discovered throughout the country embraced by the Dnieper and the Crimea, but that region has not yet been properly examined. The coal seams already discovered are, however, quite sufficient to employ a large number of hands in the work of mining. It is stated that there seems at present to be quite a mania for shaft sinking in Russia, some of the richer proprietors working for themselves the seams found under their properties, while others rent theirs to companies. The coal does not lie deep under the surface, and the intervening strata are easily pierced. The principal obstacle to an extensive working of the mines is alleged to be the great scarcity of hands. As the country is very thinly populated, and there is a great demand for agricultural labor, the supply of colliers is very limited, and even when obtained such unskilled labor is found to be not profitable. There is much waste in digging out the coal, and the work is done in a slovenly fashion; the material becomes costly, and though naturally of good quality is deteriorated by bad manipulation. As to how the difficulty will be surmounted of collecting and organizing permanent and skilled colliers in this part of Russia time must show, but till this question is solved the country cannot very well become a coal exporter to any considerable extent. It may be added that the demand in the country for steam coal increases largely, and it is probable that to properly satisfy this demand all the native production will be needed for some time.

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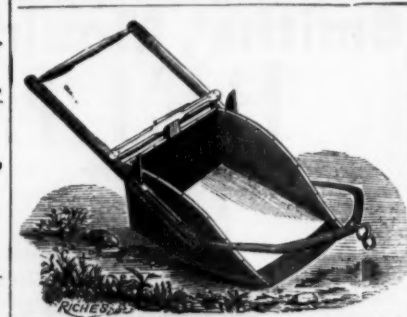
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Patent Law.*

PRIOR INVENTION.

The question of prior invention comes up for discussion constantly before the Patent Office in the proceedings technically known as "interferences," which are proceedings instituted for the purpose of determining the question of priority of invention between two or more parties claiming the same patentable subject matter. An interference is declared to be:

First.—When two or more parties have applications pending before the office at the same time, and their respective claims conflict in whole or in part.

Second.—When an applicant, having been rejected upon an unexpired patent, claims to have made the invention before the patentee.

Third.—When an applicant for a reissue embraces in his amended claim any new or additional description of his invention, or enlarges his claim, or makes a new one, and thereby includes therein anything which has been claimed or shown in any patent granted subsequent to the date of his original application, or in any pending application; provided there is reason to suppose that such subsequent applicant or patentee may be the first inventor.

The fact that one of the parties has already obtained a patent does not prevent an interference; for, although the Commissioner has no power to cancel a patent already issued, he may, if he finds that another person was the prior inventor, give him a patent also, and thus place both parties on an equal footing before the courts and the public.

From decisions given in various cases where priority of invention was claimed, the following plain rules may be deduced:

First.—The first, best and strongest title to a patent is that of an inventor who has the first conception of the invention, and afterward exercises due diligence in adapting and perfecting the same.

Second.—The second title to a patent is that of an inventor who was the first to reduce to practice, and this without reference to the time when the invention was conceived. It will not prevail against an inventor who was first to conceive, and afterward uses due diligence in adapting and perfecting the same, but it will prevail against one whose strongest title is the obtaining of a patent.

Third.—The third title is that given by the issue of a patent. Such a title as this must give way to the title of an inventor who was the first to conceive and who used due diligence afterward in adapting and perfecting the invention, and also to the title of an inventor who, as compared with the patentee, was the first to reduce to practice.

Fourth.—It would seem, on principle, that when a party has none of the three titles just specified, the inventor should prevail who can show a continuous line of effort to adapt and perfect back to the earliest date.

Fifth.—In the absence of any and all of the foregoing data whereon to base a decision, it would seem, on principle, that the inventor should prevail who was the first to embody or portray the invention, either by a machine, model, process, or drawing, so that a person skilled in the art to which it appertains could therefrom reduce it to practice. A mere oral description has been held sufficient for this purpose.

There is no limit of time within which an inventor must perfect and mature his invention, provided he can show that he exercised due diligence afterward in perfecting and adapting it. The simplicity or complexity of the invention will generally give a criterion on this point. The one important qualification of the diligence required is, that it shall be reasonable. The inventor is required to devote himself to the invention with all the continuity that is compatible with the discharge of the duties incumbent upon him in his station in life.

The step which completes an invention is reduction to practice, and this consists in the embodiment of the principles previously conceived in tangible materials—the making of a machine, manufacture or composition of matter, or the actual trial of a process—in accordance with such principles. Although by prior conception and reasonable diligence in reduction to practice, an inventor may acquire what is, at the time, an irrefragable and impregnable title to a patent, yet he may by subsequent delay and neglect lose such right by abandonment to the public. He may also lose his right by allowing the invention to be in public use for more than two years prior to his application for a patent therefor.

PUBLIC USE AND ABANDONMENT.

In the sense of the patent law, use, to be public, must be with the "consent and allowance of the inventor." Some publicity may be given to an invention without proving public use. An inventor has a plain right to put his invention in practice, even for a number of years, so long as that is done, not for profit, but with the purpose and intent to perfect or test the invention; and it is not necessarily fatal that such use is accessible to the eyes of the public. The inventor can safely call the attention of other persons to the working of his invention for the purpose of getting their judgment upon it.

It is a standard remark among judges that the subject of abandonment is a very difficult one. It is difficult because it is always a question of fact—that is, of opinion—whether an invention has been abandoned. An invention may be abandoned at any stage of its existence from first conception to final expiration of the patent therefor; but the facts that will show abandonment differ widely at different stages of the invention. If an inventor is shown to have exercised reasonable diligence in reducing his invention to practice, he has not abandoned it, if not, then he has abandoned, and an abandonment may be judged

* Abstract of Manual of Patent Law, by Wm. Edgar Simonds, of Hartford, Conn.

against an inventor, irrespective of his intention to abandon. If an inventor, after conceiving an idea, experiments or makes a model, and then does nothing more about the matter for years, when his inaction is not caused by poverty, sickness or other controlling circumstances, he will, as against the claims of another and subsequent inventor, who has conceived and been diligent in reducing to practice, be adjudged to have abandoned the invention.

Where an inventor was the first to conceive the invention, and used due diligence afterward in reducing the same to practice, he has a title to a patent therefor, which can be disturbed by no other inventor, if such title is duly asserted; but as against the claims of a rival inventor there is no reason, on principle, why the prior inventor should not be held to the same diligence in making his applications for a patent, as in reducing the invention to practice. The prior inventor would not be allowed to unreasonably delay his application for a patent, and still hold good his claim against a more diligent subsequent inventor.

THE TITLE—ASSIGNMENTS, GRANTS, LICENSES AND MORTGAGES.

The statute enacts: "That every patent, or any interest therein, shall be assignable, in law, by an instrument in writing; and the patentee, or his assigns or legal representatives, may, in like manner, grant and convey an exclusive right under his patent, to the whole, or any specified part, of the United States; and said assignment, grant or conveyance shall be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice, unless it is recorded in the Patent Office within three months from the date thereof."

There are three instruments conveying interests in patents, specified in the above quoted section—assignments, grants and mortgages. There is a fourth instrument conveying an interest in a patent, not specified in the statute, but born of the common law—a license.

An assignment is an instrument in writing, conveying either the whole interest in a patent or an undivided part thereof. It must convey to the assignee all the rights as to the portion of the patent assigned which were before vested in the original patentee. These rights are: the right to make, the right to use, the right to vend to others to use, and the right to convey any and all of the first three rights mentioned, by assignment, grant and license to other parties. Any instrument which does not convey all these rights is a mere license.

A grant is an instrument conveying the whole monopoly and rights as to a patent, originally vested in the patentee, throughout a specified portion of the United States. A grant is a territorial assignment, and must convey the same rights as an assignment, as to the territory specified, otherwise the conveyance is only a license.

An assignment, and probably a grant, can be made as well before the issue of the patent as after, and if the conveyance contains a request to that effect, the patent will issue in the name of the assignee. An assignment or grant extends to the end of the original term of the patent and includes all reissues of the patent during that term. But an assignment of a patent will not include a right to an extension of the same beyond the original term without the presence of the clearest wording to that effect. A patent cannot be attached or sold on execution for a debt of the owner. The fact that a machine is patented does not prevent its being levied upon and sold under State laws; but such a levy and sale only passes a right to the materials of which the machine is composed; it gives no right to work the machine.

The statute directs that an assignment or grant shall be recorded within three months from its date. If a patentee were to assign his patent to a person who did not within three months put the same upon the Patent Office records, and then the patentee should sell the patent to a second purchaser who knew nothing of the prior assignment, and the second purchaser should have his assignment properly recorded, he would take a legal title, and the first purchaser would have no interest in the patent; but if the second purchaser knew, at the time he took his assignment, of the prior assignment, then the second purchaser would get no title.

If an assignment or grant contains no warranty of title, or as to validity of the patent; but only a simple transfer of the assignor's or grantor's title, the assignee takes the interest pretended to be conveyed at his own risk as to the title of the assignor or grantor, and as to the validity of the patent.

A license, which is a conveyance of an interest in a patent less than an assignment or grant, need not necessarily be in writing, and does not need to be recorded. It is not a creation of the statute, but of the common law. A license is usually a permit to make, or use, or sell the thing patented, or to do two or more of these three things, and it may be an exclusive right to do all these things throughout the whole United States. A licensee cannot bring suit for infringement of a patent in his own name, while the grantee of a particular district or the assignee of the whole patent can. By means of licenses a patent owner may erect many distinct or separable interests under a patent. He may give one person the exclusive right to make the patented article in a certain district or through the whole United States; he may give to another the exclusive right to use, and to still another the exclusive right to sell; or he may give to different persons a common right to make, or to use, or to sell one or all in a certain territory or through the whole United States.

If an inventor, before procuring a patent, allows another person to make the article afterward patented or acquiesce in such making or in a use of the invention, this the law construes as a license from the inventor to such other person to use the patented thing after the grant of the patent.

Although the statute does not expressly state that patents may be legally mortgaged, it is clear from the reference in the section quoted above, to "a mortgage for a valuable consideration" that a mortgage, properly made and recorded at the Patent Office, would be held valid by the courts.

The Business Outlook.

The following from the mercantile house of R. G. Dun & Co., is worthy of attention:

There is an evident sense of disappointment abroad in the community at the slow revival of trade. The indications for some months have all been in favor of renewed activity in commercial interests, but as yet the improvement has been more in promise than in the fulfillment. While this postponement is depressing and dangerous, and while not a few houses may have to succumb to the pressure incident to such dull times, the delay is not an unaccountable one, and the promise is none the less certain. There is certainly not a very unhealthy condition apparent in the internal commerce of the country; the indebtedness is light, the stock small, a wise economy in purchasing is prevalent, and, above all, a year of great abundance has been vouchsafed to us. Monetary facilities, thanks to a wisely organized and well tested system, are adequate to all legitimate requirements, and it only needs patience and opportunity to put these facilities into active operation to revive business and ease the pressure of the times. This opportunity is likely to be afforded by the movement and marketing of the great crops that are now harvesting. It may be doubted if ever before in the history of this vast continent there were more millions of dollars' worth in the hands of producers than now. This produce the world needs—nay, must have—and in the process of exchanging it for money is the hope founded for a restored condition of trade. Since the panic of nearly a year ago there has been little opportunity for the putting out of money into general circulation. The depression of railway interests, resulting from the unwise expansion, suddenly checked expenditures on this account, while all other investments, and especially for building or for anything of a permanent character, almost ceased. Money, therefore, accumulated at the great centers, and all the winter and spring and summer there has been a plethora of money in New York, Boston, Philadelphia and Baltimore, while in other cities it has been scarce, and in almost all country localities almost impossible to obtain. The consequence has been small remittances from country merchants, equally difficult payments in their turn from jobbers, thus causing a severe strain upon the resources of importers and manufacturers. But if ever relief was promised from any pressure it is now; the abundance that the earth has produced is not only certainly secured, but it is so universally diffused, will need to be gathered from so many hands, and from such varied sections of the country, that literal streams of currency will be set in motion all over the land, which ought soon to give ease in money, and restore business in merchandise to its normal condition.

While there are numerous interests that will feel the influence of this free circulation of money, there are many departments of commerce that it will take longer time and more favoring circumstances to revive. Excesses of all kinds must be atoned for, whether in the construction of railways, the building of warehouses and dwellings, the production and manufacture of iron, lumber, or any other system of overtrading. It will take more than a year, and that of restricted trade; more than one crop, abundant though it be, to restore the equilibrium of supply and demand for things that the people can and will do without. But for the revival of legitimate trade and profit in merchandise, for the filling of the wants of customers, great faith may reasonably be placed in the movements of the crops.

It will take some months to accomplish all that is hoped for in this movement, for the very abundance of the product may retard its realization. Lower prices than have been paid for some time may prevail, and farmers and planters are slow to sell in a declining market. We have heard of cases where suits for collection of debts have been defended for time, in the hope of a rise in price. But whether it takes weeks or months, whether the deliveries are early or late, the wealth is in the country, and must be realized; and the hope is a reasonable one, that very soon this peculiarly aggravating and trying season of depressed trade in merchandise will be succeeded by a more gratifying condition of things.

According to Professor Abbe, of Jena, the limit of capability of a microscope in showing the structure of tissues and the character of minute objects has nearly, if not entirely, been reached, higher power than those now in use giving rise to optical phenomena which are likely to completely mask the structure and character of the object under examination. Thus it may happen that while different structures give the same microscopical image, like structures will give different images; and while systems of the fine lines and the like may appear ever so distinct and well marked in the microscope, we are not entitled to regard such appearance as of morphological significance, but merely as physical phenomena from which nothing can be inferred except the presence of such structural conditions as are capable of producing the diffraction effects obtained. These observations apply more especially to the marking of certain diatoms and striated muscular fiber. According to Professor Abbe, by no microscope can parts be distinguished if they are so near to each other that the first bundle of light rays produced by diffraction can no longer enter the object simultaneously with the undiffracted cone of light.

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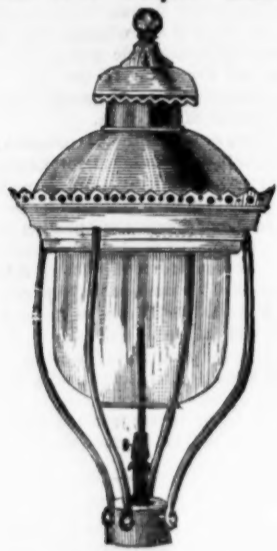
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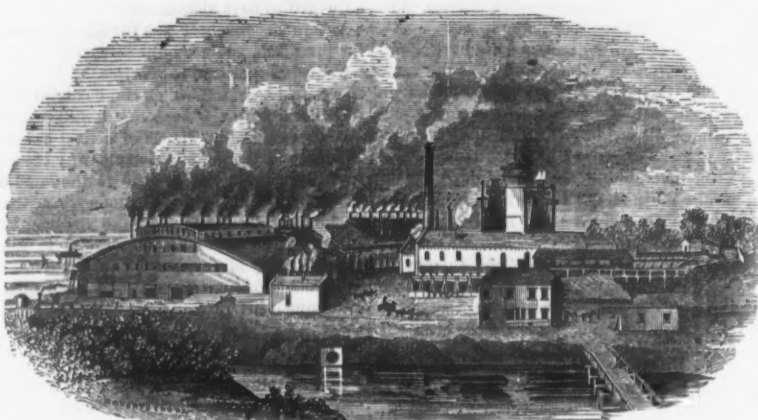
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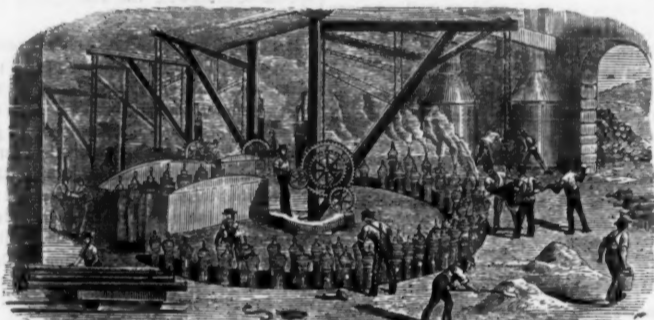
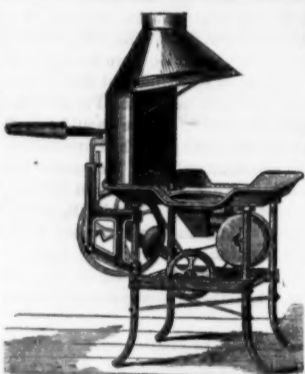
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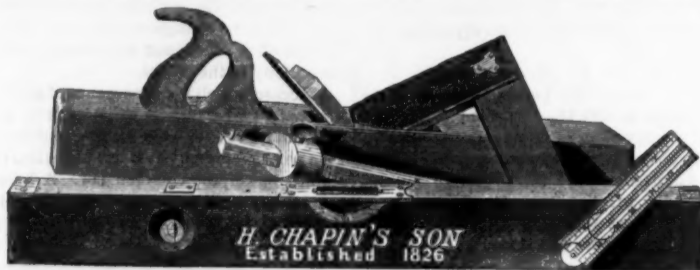
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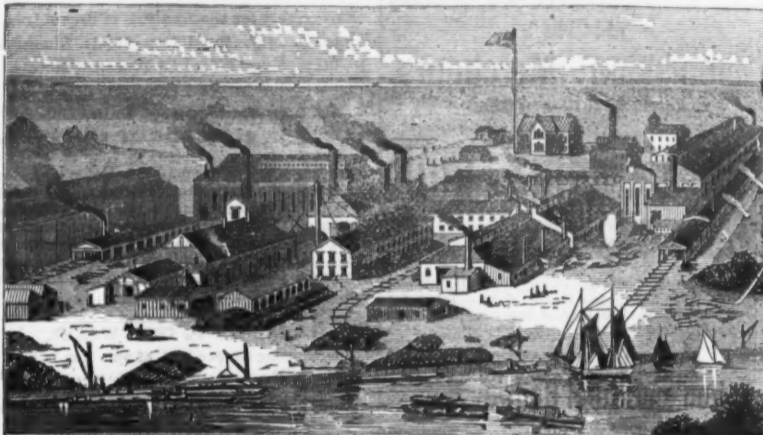
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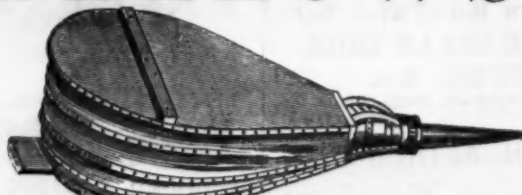
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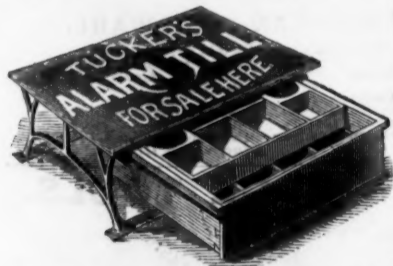
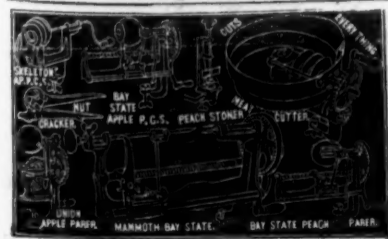
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Machines (does all at once)..... 9 doz. \$15 00

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Machines (does all at once)..... 9 doz. 8 50

Union Improved Apple Parer..... 9 doz. 8 50

Bay State Peach Parer..... 12 doz. 12 00

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Meat Cutters..... 9 doz. \$30 00 and \$75 00

"Skeleton" and "Velox" in 50 doz. lots, 9 doz.

\$8 00. Other kinds included at 1 per cent. discount

from list. Terms, 30 days, or 5 per cent. discount if

sight draft be made on shipment.

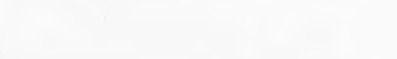
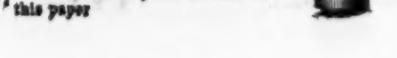
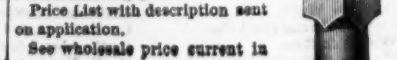
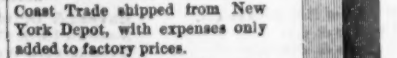
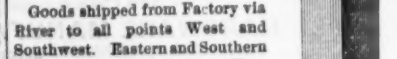
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PIPE.**Factory, CHARLESTON,
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River to all points West and
Southwest. Eastern and Southern
Coast Trade shipped from New
York Depot, with expenses only
added to factory prices.Price List with description sent
on application.See wholesale price current in
this paper**Atlantic Telegraphs.**

A few years ago the Atlantic yacht race caused a great sensation. This year we have a still more novel race—an Atlantic telegraph cable race.

Within the next few weeks two huge ships—the Great Eastern and the Faraday—will be paying out their cables across the Atlantic for rival contractors and rival telegraph companies. Unfortunately the paying out of these cables will take place in opposite directions. The Great Eastern starts from Newfoundland, and is to lay her cable toward Ireland, and the Faraday starting from the Irish side is to lay her cables toward Newfoundland. Had the ships both started from the same side, and if the two contracting firms could have been induced to let the ships start at the same moment, the arrival on the opposite coast would have been an event that might have caused the greatest excitement in the letting ring as well as in that most speculative of all bodies, the Stock Exchange.

As it is the event will be watched with interest, as this is the first time that the contract for laying an Atlantic cable has been attempted by any other contractors than the Telegraph Construction Company. As many of our readers may scarcely recollect the history of Atlantic telegraphs, the following brief sketch may be of interest.

In 1857, the first attempt at an Atlantic telegraph was made. The cable was manufactured for the Atlantic Telegraph Company by Messrs. Newall & Co., who then had works at Birkenhead, and Messrs. Glass & Elliott, who had works at Greenwich, each manufacturing one-half of the cable required, the core being supplied to each firm from the Gutta Percha Company, Wharf road, London. The laying of the cables was undertaken by the Atlantic Telegraph Company, Messrs. Bright, Canning, Woodhouse and Webb being appointed engineers.

At that time the Great Eastern was only just launched, and was not disposable for telegraphic work. No ship except her could have carried an entire Atlantic cable, and the company applied to the English and American governments, who, in consideration of the international nature of the work, lent the Atlantic Company H. M. S. Agamemnon, a 90 gun screw line-of-battle ship, and the steam frigate Niagara.

As the cable had to be laid in two halves, it became a question as to whether one ship should pay out her half first from one shore and the other join on, or whether they should splice in the middle and pay out to shore. It was after some discussion decided that the Niagara should pay out her half from Ireland, and that the Agamemnon should then splice on and proceed, so that an American ship should have the honor of handing the first end to an English shore, and the English ship offer the final end to our American cousins.

The expedition started, and 350 miles had been paid out from the Niagara, from Ireland toward America, when the cable parted, and the expedition returned to England. The next year, 1858, they started from the center, Messrs. Bright, Canning, Whitehouse and Everett being the engineers, and, after various mishaps and a fearful gale of wind, returned to port; went to sea again, started again from mid-ocean, and finally laid the cable. Mr. Bright was knighted by the Lord-Lieutenant of Ireland. Mr. Cyrus Field, who had been one of the most energetic promoters, was feted and serenaded at New York. The cable sent a few telegrams, and then declined, through imperfect insulation, until it refused to speak. Recriminations and long letters in the press followed, and the cause of Atlantic telegraphs remained dead for six years.

In 1864, through the exertions of Mr. Glass, managing director of the Telegraph Construction Company—a company formed by the amalgamation of the firm of Glass, Elliott & Co., and the Gutta Percha Company—Mr. Cyrus Field, and Mr. Seward, secretary of the Atlantic Telegraph Company, and others, sufficient capital was obtained by the Atlantic Telegraph Company to permit them to enter into a contract with the Telegraph Construction Company for the attempt to lay another Atlantic cable in 1865. The Great Eastern had been engaged by the Telegraph Construction Company. Mr. Canning was the engineer for the Telegraph Construction Company, and Mr. C. F. Varley the electrician for the Atlantic Telegraph Company.

The pattern of the cable this year differed from that of 1857-'8. The outer covering of the 1858 cable consisted of strands of fine iron wire, that of 1865 consisted of homogeneous iron wire each separately covered with Manila hemp saturated in tar. The cable was shipped on board the Great Eastern. Two thirds were paid out successfully, when a fault of insulation occurred, the cable was shifted to the bows to be hauled in, and finally parted. It was dredged for, but although hooked the machinery and tackle proved insufficient to lift it, and the expedition returned.

By strenuous efforts capital was raised for another attempt, in 1866, to embrace the manufacture and laying of a complete cable and the attempt to complete the 1865 cable for the Anglo-American Telegraph Company—a new company formed, to whom the Atlantic Telegraph Company may be said to have sacrificed themselves. The expedition started under the direction of Mr. Canning. The new cable (almost exactly similar to that of 1865, except that the Manila hemp was untarred) was successfully laid, and the end of the 1865 cable was grappled up, the cable on board spliced on, and paid out successfully to Newfoundland, thus giving two cables to the Anglo-American Company.

Mr. Canning, the engineer, Captain Anderson, commanding the Great Eastern, and Professor Thompson, who had acted as electrician, and Mr. Glass (the managing director of the Tele-

graph Construction Company) were knighted, and Mr. Curtis Lampson and Mr. Gooch, directors of the Atlantic Telegraph and Great Ship Company, received baronetcies; and since then Mr. George Elliott has also been made a baronet. The French Atlantic cable from Brest to St. Pierre (an island near Newfoundland) was laid from the Great Eastern in 1869 under the superintendence of Sir S. Canning, Messrs. Clark and Forde being the engineers for the French Atlantic Telegraph Company, and Captain Halpin being in command of the Great Eastern. Last year another Atlantic cable was laid from the Great Eastern under the superintendence of Captain Halpin, on the part of the Telegraph Construction Company, Messrs. Clark and Forde again being the engineers and electricians for the Anglo-American Telegraph Company.

The Anglo-American Company's cable of 1865 failed on March the 11th, 1873, and has not yet been repaired. Captain Halpin, in the Great Eastern, made the attempt to repair it last year, and failed to do so, and, indeed, it appears that the line of cable never was dredged over.

The 1866 cable failed on the 18th of May this year, but has been repaired by Captain Walsh in the steam ship Minia, which the Anglo-American Telegraph Company have just bought and fitted out as a cable ship.

This brings us to the present date as regards Atlantic telegraph chronology.

At the present moment, then, we have the Anglo-American Telegraph Company possessing the 1866 cable, the French Atlantic of 1869, and the 1873 cable in full working order, whilst the Great Eastern is by this time, no doubt, commencing to pay out her 1874 cable from Newfoundland, toward Ireland, for the same company.

Messrs. Siemens Brothers, who have undertaken to lay an Atlantic cable for the Direct United States Cable Company, have already laid a portion of their line, the cable having been laid from Portsmouth, New Hampshire, to Torbay, in Nova Scotia, and on to a point near the coast of Newfoundland, in Conception Bay, where the end is buoyed. The steamship Dacia has snipped the English shore end and intermediate pattern cable, which is to extend in all to about 180 miles from Ireland, and has proceeded to Ireland and laid it, the end being buoyed. The Faraday has shipped the main cable at Messrs. Siemens' works at Charlton, has left the Thames, and will soon commence laying the cable from the point where the Dacia's cable terminates to the buoy on the other cable already laid, up to Newfoundland. Should certain concessions held by the Anglo-American Company, and on the strength of which the original and ill-paid promoters of Atlantic telegraphs staked their money, be overridden, the Direct United States Company will eventually land their cable in Newfoundland, and thus compete with their single cable against the four existing cables of the Anglo-American Company; but we fall to see on what grounds this company, which already touches at one point between Ireland and the United States, and is so very desirous of touching at a point still more out of a direct line between Ireland and the United States, can honestly call itself a direct United States cable, particularly as the original line was advertised as a line to be laid "from the coast of Ireland to a point on the coast of New Hampshire."—*Engineering.*

The Process of Stamping Tinware.

The manufacture of seamless goods from tin plates, by machinery, was introduced into the United States about the year 1860. A few years previous to that date, tinued goods, such as plates, pans, jelly molds, &c., had been made from one piece of metal in France and elsewhere in Europe, but it was not until about fourteen years ago that the process was in successful operation in this country. About that time machinery was brought from France, and this branch of mechanical industry, which has since grown to be of such large proportions, was fairly inaugurated. Pending the introduction of the French machines, the process of stamping metals had been elaborated and got into successful working order by Charles Hodggets and William Taylor, in this city. The two methods—the French, and what we may call the American—both attain the same result, and the principles governing them are alike; they differ only in minor details, and in the construction of the machinery used.

Stamped goods were made at first by means of a drop press, but this method was open to objection, principally on account of the liability of tin plates, unless of exceptionally good quality, to crack in the working, thereby causing considerable loss of material. The process now in use was adopted about ten years ago. By its operation the pressure brought to bear upon the metal in the successive stages of manufacture is more gradual, there is no sharp impingement—such as would be caused by the falling of a drop hammer—fractures are of rare occurrence, and a great saving in material is effected.

In stamping tin plates into such forms as may be desired, the first operation is that of cutting the blank of the requisite size and shape from the tin plate. This is done, generally, by means of an ordinary drop press. The blank is then transferred to the stamping machine, where, by means of a device that cannot be adequately described without illustrations, the flange is so held during the pressure of the descending die as to keep it perfectly flat, and free from the force brought to bear upon the rest of the plate. The flange by this means retains the same thickness as the original plate, while, at the same time, its shape is preserved, the corrugation being confined to the sides of the basin. The descending weight containing the die is governed by the machinery through out, and does its work by gradual and steady pressure. Successive dies are used, each one

smaller in circumference than its predecessor until the required depth is obtained. The nature of the plate is such that it has been found necessary to use dies of moderate depth, and to prefer a succession of strokes to endeavoring to make articles of much depth at one operation. The metal forming the sides of the basin is necessarily stretched in the operation to some extent, and the tin plating is made to cover a larger space than when in the blank, while on the flange and bottom it retains its original condition. It consequently becomes necessary, for the purpose of securing uniformity in the plating, to have many of the manufactured articles retinned. The corrugations on the sides of the basin are smoothed out with a burnishing iron on a lathe, as in the manufacture of spun goods.

The presses used are of great strength, and can be adapted to the production of any size of article that may be required. One man is required to attend each press, and he is kept busily employed.

When the article has been stamped into the required shape, it is removed to another machine, where the flange is turned over and wired. It is then ready for the spinner, who smooths out the corrugations and gives it an even, regular surface. Some kinds of goods, such as dust pans, &c., are frequently put on the market without the corrugations being removed, but the great majority of stamped wares, when they are of any considerable depth, are spun before being retinned.

The tendency of iron to crack under such pressure as is brought to bear upon it in the stamping process, has made it necessary for the manufacturers to use only the best charcoal plates, as it has been found that it is more profitable in the long run to do so than to employ inferior metal.

The number and variety of articles now made by this process is almost endless, and additions are being continually made to the list.

The advantages claimed for stamped goods over those made by the old methods are many and important. The absence of seams, rendering the use of solder unnecessary, and affording no place for water to lodge and cause rust, is one of the most important of their claims to superiority. For such articles as milk pans, &c., that require when not in use to be thoroughly clean and dry, the absence of any place where liquids could possibly lodge is a matter of considerable moment.

The same method of stamping is also applied to other metals beside tin plate. Copper and brass basins, &c., are made by the same or similar machines.

The Centennial Memorial Building.

Out of all the plans for the Centennial Memorial Building which have been submitted, one has been selected which seems to satisfy all the requirements, and from the details of this plan a fair idea of the style and character of the edifice may be gathered.

As studied from the drawings and specifications of the architect, the structure is on a line parallel with and northward of the main Exhibition Building. It is on the most commanding portion of the great Landsdowne plateau, and overlooks the city. It is on a terrace six feet above the general level of the plateau, the plateau itself being 116 feet above the river.

The style of the outer structure is in the modern renaissance, massive and graceful in outline, and in consonance with the general park character. The material is granite, glass and iron. No wood is used.

The structure is 385 feet in length, 210 feet in width and 59 feet in height, over a spacious basement 13 feet in height; the whole surmounted by a dome 150 feet high.

The main front looks southward. It displays three distinctive features; first a main entrance in the center of the structure, consisting of three colossal arched doorways of equal dimensions; second, a pavilion at each end; third, two arcades connecting the pavilions with the center. The central section is 95 feet long, 73 feet high; pavilions 45 feet long, 60 feet high, and arcades each 90 feet long, 40 feet high.

The front or south face of the central section displays a rise of thirteen steps to the entrance, 70 feet wide. The entrance is by three arched doorways, each 40 feet high and 15 feet wide, opening into a hall. Between the arches of the doorway are clusters of columns, terminating in emblematic designs illustrative of science and art. The doors, which are of iron, are relieved by bronze panels having the coats of arms of all the States and Territories.

In the center of the main frieze is the United States coat of arms. The main cornice is surmounted by a ballustrade with candelabra; at either end is an allegorical figure representing science and art.

The dome rises from the center of the structure to the height of 150 feet from the ground. It is of glass and iron, and of a unique design. It terminates in a colossal bell; from this the figure of Columbia rises with protecting bands. A figure of colossal size also stands at each corner of the base of the dome—these figures typifying the four quarters of the globe.

Each pavilion displays a window thirty feet high and twelve wide. It is also ornamented with tile work, wreaths of oak and laurel, thirteen stars in the frieze, and a colossal eagle at each of its four corners.

The arcades, a general feature in the old Roman villas, are entirely novel here. They are intended to screen the long walls of the gallery. They each consist of five grained arches. These arcades form promenades, looking outward over the grounds and interiorly over open gardens, which extend back to the main wall of the building. These garden plots are each 90 feet long and 36 feet deep, ornamented in the center with fountains, and designed for the display of statuary. A stairway from the garden reaches the upper lines of these arcades, which forms a second promenade 35 feet above the ground. Its ballustrade is ornamented with vases, and is designed ultimately for statues. The cornices, attics, and crestings throughout are highly ornamental.

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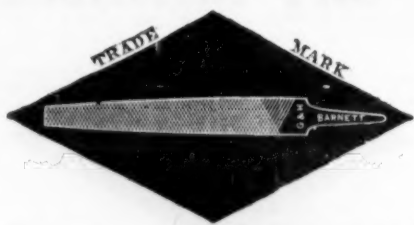
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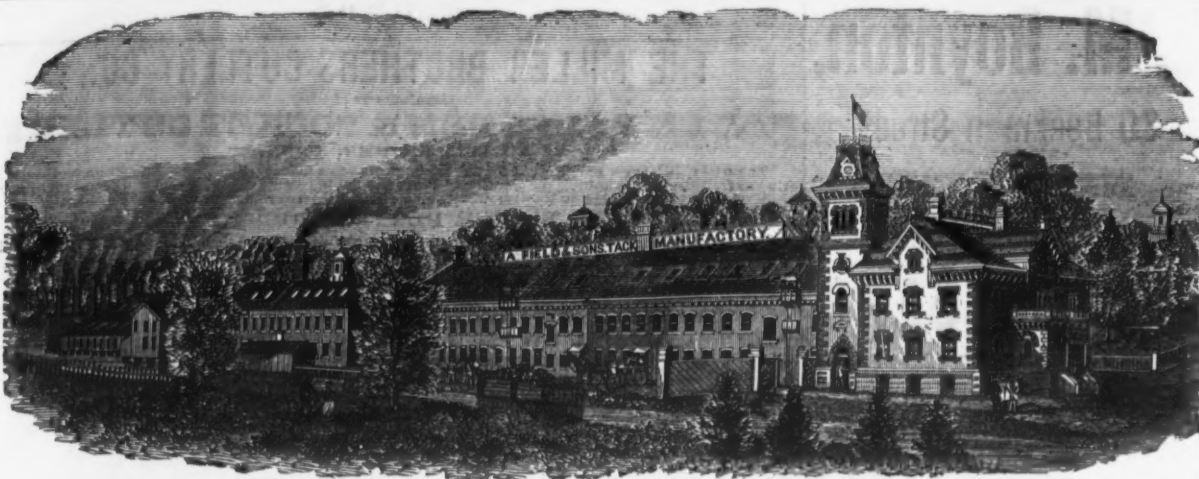
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Manufacture Iron Chain of every description.
Mowing Machine, Crane, Break,
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Also, Latest Improved Cotton Gin Rings.
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Of all descriptions.
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SHOVELS, SPADES & SCOOPS
Of all Descriptions.

Without straps or rivets, of the best English and American Cast Steel. Every Shovel warranted. Printed lists of prices and discounts to be had on application at the office.

SOLE AGENT,
H. K. DRAKE, 31 Chambers St., N. Y.

BUSINESS ITEMS.

NEW YORK.
The Brooks Locomotive Works, at Dunkirk, are gradually increasing the force, and have now about 150 men at work.

PENNSYLVANIA.
The Butler County Mining and Manufacturing Company has been organized at Harrisburg, with a capital of \$300,000. A large tract of coal, iron and limestone lands have been leased in Marion and Venango townships. The officers are as follows: B. Heidrick, president; William Barnum, treasurer. The directors are B. Heidrick, of East Brady; William Barnum and Henry Rawle, of Erie; John Adams, of Armstrong county; Charles Meek, of Sharon; Jonathan Snyder, of Mercer county. George H. Moore was elected secretary.

The furnace at South Easton, which has been undergoing repairs, will be completed and blown in in the course of a few days.

The Messrs. Pott & Bro., boiler makers, of Lebanon, have received an order to build a 50 horse-power boiler for parties in New York.

Both of Lewis, Oliver & Phillips' works, at Pittsburgh, are running full double turn. At their South Side works they have erected a new building (all wrought iron and put together in their own shops), in which they are placing eight new puddling furnaces. Their new foundry, a square above, is completed and in operation.

The Middlesex Manufacturing Company, of Sharon, whose extensive shops have been idle for some time, has resumed operations.

The Wood's Rolling Mill, at Temperanceville, will, it is said, be started during the winter to work up scrap iron.

CONNECTICUT.
The Pratt & Whitney Company, of Hartford, still continue to make foreign shipments of their machinery, as will be observed from the fact that they have recently shipped to Sweden machinery for the manufacture of sewing machines in that country.

The Meriden Britannia Company has received an order for six elegant German silver fire trumpets, two of them of extra size, and for two shovels or spades. They are for the society (a fire company) of Salvador, Lima, and are to be used at the obsequies of a former captain, Francisco Estervan Valmede. The whole are valued at \$600.

MAINE.
The Patten Car Works, of Bath, have received an order from the Dominion government of Canada for three first-class passenger cars for the Inter-Colonial Railway, of Canada.

OHIO.
Diebolt, Morris & Co., safe manufacturers of Canton, have been awarded the contract for the erection of a monster vault for the Duncan Safe Deposit Company, of San Francisco, the same to cost \$100,000 and to contain 4000 small safes inside of it.

The Eclipse Double Turbine Water Wheel is manufactured at Dayton, by the Stilwell Manufacturing Company, who also make the Stilwell patent lime extracting heater. This company has shipped their water wheels even to Japan, they having received orders from the Japanese government for several of their wheels. Their heater and filter, it is claimed, will prevent incrustation in steam boilers, and removes all impurities from the water before it enters the boilers. There are at the present time 3000 of them in use.

The Phoenix Iron Works, Tucker & Gregory, proprietors, Ashtabula, manufacture steam engines and machinery of all varieties. The firm last fall erected a two story brick shop 34x75 feet, and are now building a foundry 45x70 feet. They are doing a good business in this fall of dull times.

The Ashtabula Rolling Mill Company has in course of erection a new rolling mill, which it is expected will be in operation in about two months. The managers are Messrs. Deuty & Harris, lately connected with James Ward & Co., Niles.

The works of the Girard Rolling Mill Company, at Youngstown, are being much increased. Their new addition is now finished, and is 130x46 feet, and will contain the necessary machinery for making nuts, bolts, washers, car links and pins, etc. The wing of this addition is 30x50 feet, and is used as a machine shop for repairing their own machinery. Still another addition has been commenced, 40x50 feet, to contain six puddling furnaces, which will make 16 in all; there are already in use three trains of rolls; also seven engines—one of 140 horse-power, and one of 100, one of 80, and four of 10 horse-power. These works, when in full blast, will make 40 tons of iron per day, and will employ 150 men.

Ophir Furnace has put in hot blasts, and will now be able to make hot and cold blasts ad libitum. She is now making the former.

The Cincinnati Iron Bridge Works (J. W. Shipman & Co.) lately shipped two of their excellent bridges to Crawford county, Pennsylvania. They have the contracts for an iron truss bridge of 150 feet span at Indianapolis, for the bridge at Greensburg, Ind., a railroad bridge at Norwood, and several others in various parts of the country.

It is reported that the Niles Iron Company intend moving their mill to Youngstown.

ILLINOIS.
The Springfield Iron Company, of Springfield, have commenced the manufacture of the Nes silicon steel rail.

The Union Malleable Iron Works, of Moline, employ fifty men, and turn out as good malleable iron as is made. Their present daily production is 3000 pounds finished malleables.

WISCONSIN.
Messrs. White & Uring, of Milwaukee, have just completed the erection of an extensive establishment for the manufacture of pressed

ware. They will employ from 50 to 75 workmen at once.

MISSOURI.
The Laclede Rolling Mills, of St. Louis, after extensive repairs, resumed operations Sept. 1st. The capacity of the mills is about forty tons of bar and sheet iron daily; 350 men are employed.

The Electric Alarm Water Gauge Company, of St. Louis, has commenced active operations in office and manufactory. The officers are: J. C. Porter, president; S. B. Kellogg, vice president and treasurer; E. E. Kellogg, secretary; Charles Heisler, superintendent of manufactory. The company will manufacture and deal in telegraphy and electrical machinery, batteries and supplies, hotel, house, and fire indicators and alarms.

The Bessemer steel works of A. Meirer & Co., St. Louis, will, when completed, be a very extensive establishment. The capital of the company is \$1,000,000. The works are located on the river bank, directly opposite Carondelet, and the property embraces 100 acres of land with a frontage on the river of 1197 feet. There will be two blast furnaces, each 60 feet in height, 17 feet at bushes, and 13 feet tunnel head. The East St. Louis and Carondelet Railroad runs through the property, also a narrow gauge road to Cairo and the big muddy coal fields. The works are expected to be in operation early in 1875, and will employ 250 hands.

Mr. J. Emelauer has lately completed for the Ohio & Missouri Lead Company a reverberatory or L furnace of the following dimensions: Length through, from work door to lead door, 13 feet; of L across furnace, 13 feet; breadth of bottom at bridge, 3 1/2 feet across; breadth across furnace front at work door, 8 feet; height of furnace, 8 feet; fall of arch, 1 foot 3 inches; height of arch, 10 inches; chimney, 50 feet 20 inches diameter.

KENTUCKY.
The workmen in Gaylord & Co.'s iron pipe factory, at Newport, numbering 250 persons, struck on the 7th inst. against a reduction in their wages of ten per cent., and the factory was closed. There was no disturbance.


The Blake Stone Crusher for Road Making.

We reprint from the Ogdensburg (N. Y.) Daily Journal, of a recent date, the following extracts from an article giving not only an account of the operation of the Blake Stone Crusher, but a description of a complete stone-breaking apparatus for road making purposes, and a statement of the cost:

On the 15th of July the taxpayers of this city voted to raise the sum of \$3000 for the purpose of purchasing a stone crusher and engine to propel the same. At the next meeting of the common council thereafter, Austin, Hall and Power, with the mayor, were appointed a special committee to make the purchase, set up the machine, and place it in running condition. They proceeded at once to perform their duty. The crusher, engine and boiler were procured, and an engine and boiler house erected on the lands belonging to the city at the corner of Gates street and Madison avenue. A suitable building has also been erected for the crusher. Everything has been done in the most substantial manner. These buildings have been erected on the solid rock, which affords a foundation which nothing can disturb. The engine and boiler rest upon this rock. The crusher is placed in an elevated position about twelve feet above the rock flooring, giving that much of a fall for the broken stone to pass out after being crushed. The flooring upon which it rests is on a level with the surface of the ground above the quarry, making it convenient for teams to draw in the stones to be crushed. Everything was completed and placed in working order on Saturday, 20th, six weeks after the appointment of the committee. Notice was given that the machine would be set to work yesterday afternoon, and the public invited to attend. It called out many of our large taxpayers, business men and mechanics. About 2 p. m. the machine was set to work. It acts on the principle of compression, and stone which will measure 10x10 inches are taken into its iron jaws and crushed into McAdam as fast as three men can conveniently handle them. In less than an hour one and a quarter to one and a half cords were crushed, and we should judge that its capacity is ten cords of broken stone per day of ten hours.


The only expression heard during the trial was that of surprise and admiration. We doubt if there has ever been a trial of a labor-saving machine which has given greater satisfaction than that of our stone crusher yesterday afternoon. The cost of breaking McAdam for our streets is by this means reduced from \$10 @ \$12 per cord to \$1 per cord.

The 1st of November has been fixed as the date for running the first train through the Hoosac Tunnel. The Governor and Council meet on the 9th inst. to rectify a contract with the Messrs. Shanley whereby steel rails are to be laid through the tunnel, instead of iron rails, as provided in the original contract. The State will pay the difference in cost. It is thought the track can be connected at the east end and laid through the tunnel in four weeks, steel rails being already on the way. It is possible that the running of trains may be delayed until December 1 on account of delay in the construction of bridges on the new track this side of the mountain, one of which has been but recently contracted for. An arrangement is to be made with the contractors for the arched work near the central shaft to permit the running of the freight and one passenger train each way each day. This work will be prosecuted six months. The repairs of the Troy and Greenfield Road are to be begun next week. The whole line is to be relaid with steel.

GEORGE GUEUTAL & SON,
39 West 4th St., New York.
IMPORTER OF
 **Wood Screws, Steel in Sheets,**
BAND SAWS, TOOLS FOR BRAZING, &c.
Bed Screws, Pin Hinges, and Wire Nails a Specialty.

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MANUFACTURER OF
SAWS OF ALL KINDS.
FACTORY, WILLIAMSBURGH, N. Y.

AMERICAN SAW CO.,
TRENTON, NEW JERSEY.



PERFORATED CROSS-CUT SAWS.
EVERY SAW WARRANTED.
GUMMING AVOIDED. "PREMIUM" FILING MADE EASY.
AMERICAN SAW CO., NEW YORK.

Solid saws require frequent gumming, thereby subjecting them to risk of springing or breaking. This is especially the case with cross cuts having Patent Teeth. In the perforated saws all gumming is avoided and the teeth are easily kept long and in proper shape, saving files, labor, expense and vexation. As is well known, our saws cut faster, smoother and easier than any other.


MOVABLE-TOOTHED CIRCULAR SAWS AND SOLID SAWS OF ALL KINDS.

Hankins' Elliptic Forked Saw Frame.
Patented June 28th, 1870.



The annexed engraving represents HANKINS' ELLIPTIC FORKED SAW FRAME, which commends itself to the trade for its simplicity of construction. The Forked Frame being all in one piece, without any center bolt, secures for the frame great strength and durability. These frames are put up with my best Webs, marked "No. 40, Harvey W. Peace."

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VULCAN SAW WORKS,
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**THE SILVER STEEL
DIAMOND CROSS-CUT SAW.**
\$1.50 Per Foot.  Patent Secured

THIS new Saw, which is destined to take the place of all Cross-cut Saws in point of **SPEED AND EASE**, is manufactured by E. C. ATKINS & CO., Indianapolis, Ind., who are the **SOLE MANUFACTURERS FOR THE UNITED STATES.** So confident are we that this is the best Cross-cut Saw in the market that we CHALLENGE THE WORLD. Orders promptly filled.

E. C. ATKINS. H. KNIPPERBERG.
Saw Manufacturers and Repairers, Indianapolis, Ind.

J. FLINT & CO.
Manufacturers of all kinds of **SAWS AND PLASTERING TROWELS.**
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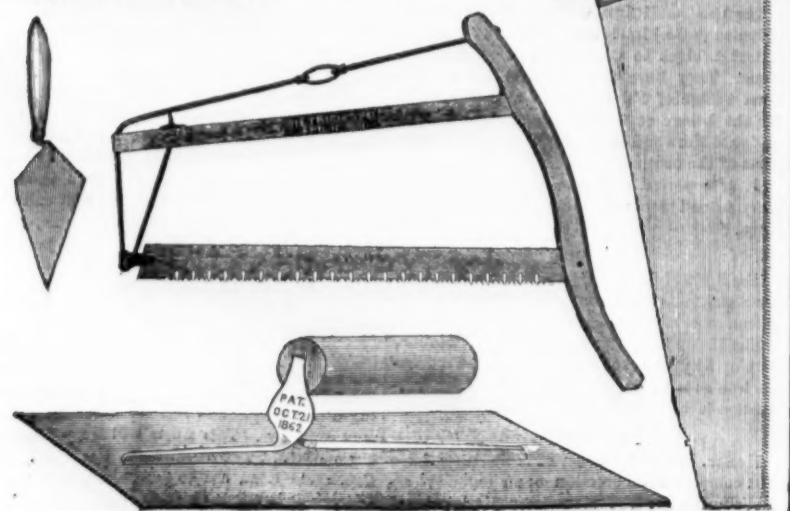
Dietrich's Patent Wood Saw. Guaranteed the strongest, lightest, easiest to strain or tighten and best braced wood saw made; also to give perfect satisfaction.

Dietrich's Patent Double Handle Rip Saw. All will readily see the benefit of this useful invention.

J. Flint's Patent Plastering Trowels. The best made and finished Trowels in the world. We make four grades of Plastering Trowels, from the best to the cheapest.

Our patent method of grinding hand saws makes them superior to any in the market.

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Manufacturer of

LIGHTNING SAWS.

Two Direct Cutting Edges, instead of one Scraping point.



Note extra steel and durability over the old V, outlined on the tooth.

I am willing and extremely anxious, on proper notice, to accept a Challenge from H. Disston & Sons, or any responsible Saw Manufacturer, and am ready to back my words with appropriate deeds and \$500 expense, if beaten.

N. B.—With Hand, Billet or Cross Cut Saw, \$500 on each.

E. M. BOYNTON.

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WARRANTED
PATENT GROUND
SECOND TO NONE
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I make a specialty of the **LARGEST SIZES** of Circular Saws, and call particular attention of lumber manufacturers to the following points of excellence:

Evenness of Temper.—The peculiar structure of my furnace subjects all parts of the saw to a DEAD heat, and when dipped in the oil bath secures perfect uniformity.

Perfect Accuracy in Thickness.—My saws are ground on a patent machine, automatic in its operation, grinding off the thick places upon the plate before the thinner parts are reached, and when the saw is removed BALANCES PERFECTLY, which is proof positive of the right accomplishment of the work.

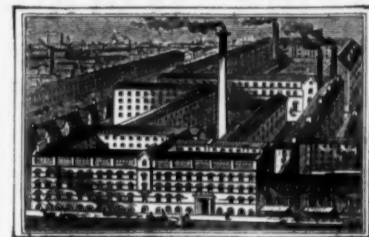
Properly Hammered.—Great care is taken that no saw shall leave my works without due attention in this important particular. A saw too tightly strained upon the rim, or too loose in the center, cannot be successfully run—hence the importance of so hammering the saw as to effect equal strain in all its parts, and at the same time RUN TRUE. This department is under the personal supervision of myself, who has devoted over twenty years to the art of saw making.

I am sole proprietor and manufacturer of the celebrated "Challenge" Cross-Cut Saw. Price Lists of all kinds of saws sent on application.

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to Cleanse Wire, &c.**

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SWAN QUILL Action!
**SPENCERIAN
STEEL PENS.**

These Pens are comprised in 15 numbers; of the NUMBER ONE PEN alone we sold more than

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In 1873.

and the sale is continually increasing. They are of superior English make, and are justly celebrated for their elasticity, durability, and evenness of point. For Sale by the trade generally.

To accommodate those who may wish to try these Pens, we will send a Sample Card, containing all of the 15 numbers, by mail on receipt of 25 cents.

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THE MILLER BROTHERS CUTLERY CO.,
Manufacturers of
PATENT FINE PEN & POCKET CUTLERY
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The only Knives made that are put together in such a manner that there is no strain on the covering or frail part of the knife. We warrant our knives equal in cutting qualities and workmanship to any made, and are acknowledged by English makers as the **Best American Knife.** We also make

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which will not rust or become discolored when used as a Fruit Knife, and their cutting qualities are equal to any other knife. Orders filled from the factory or by

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**AMERICAN
PEN AND POCKET KNIVES,**
MANUFACTURED BY **PEPPERELL,**
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My Blades are forged from the best Cast Steel and warranted. To me was awarded the GOLD MEDAL of the Connecticut State Agricultural Society; also a Silver and Diploma from the Mass. Mechanics' Ass'n Sept., 1860.

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Mill, Hand, Roberts' and
other Wood Saws,
&c., &c

Cast Steel Files
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Manufactured from
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PYROMETERS
for BLAST FURNACES.

**E. BROWN'S STANDARD PORTABLE,
E. Brown's Improved
Gauntlet**


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ALSO FOR SALE
PYROMETERS
For Baker's Ovens, Boiler Flues,
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E. Brown's Portable Blast Gauge
for the plug hole, Steam Gauges,
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Counters, Indicators for ascertain-
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Over 300 "Gauntlett" and 100
Portable Pyrometers are now in
use at Blast Furnaces.
Circulars on application.

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WOSTENHOLM'S
(IXL)
POCKET KNIVES,
KNIVES & FORKS,
RAZORS,
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Wood's Hot Water-Proof Table Cutlery.

Handsome, Cheapest, most Durable Cutlery in use.
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IN GREAT VARIETY.

Extra Hard Rubber Handle Table Cutlery of our own Manufacture.

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TABLE KNIVES AND FORKS OF ALL KINDS,
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And the "Patent Ivory" or Celluloid Knife. These Handles never get loose, are not affected by hot water, and are the most durable knives known. Always call for the Trade Mark "MERIDEN CUTLERY COMPANY" on the blade. Warranted and sold by all dealers in Cutlery, and by the MERIDEN CUTLERY CO., 49 Chambers Street, New York.

CORPORATE MARK,



Joseph Rodgers & Sons' (LIMITED)

CELEBRATED CUTLERY,

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PATENT STOP GATES For Water, Gas and Steam,

From 2 in. to 50 in. diameter.

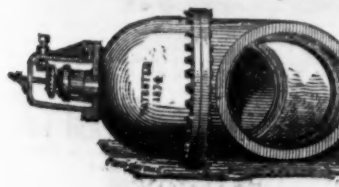
Also, Fire Hydrants, Single and Double Nozzle.

Improved Boiler Feeders, Etc.

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Send for Circular.



PHILADELPHIA CORRESPONDENCE.

PHILADELPHIA, Sept. 14th, 1874.

The continued drought, together with the protracted drought through which we are passing, tend to keep people out of town and depress trade, but there is slightly more business doing, and a generally more hopeful feeling, although, indeed, the best is bad enough. A peculiar coincidence of figures, in connection with the late panic, is that the stock of the Pennsylvania Railroad Company sold in this market on Monday, Sept. 7th, 1874, at precisely the rate brought on the same day one year before, and thirteen days before the Jay Cooke panic, viz., 53%. Whether the condition of the company was ever really such as to justify the depreciation this stock underwent may be doubted, but, at all events, it took a year, less thirteen days, to overcome the effects of the panic. The forthcoming report of the condition of the company promises to show an extremely prosperous condition of affairs, and has, without doubt, given this appreciation to the stock. In my last I referred to Lohse's patent fuel, a method of compressing coal slack which the inventor has been indefatigably at work at for some years, and which offers, of course, great profit when successfully carried out. This result would seem to have been reached, as the "Lohse Pressed Fuel Company" has been formally launched with prominent coal men in the directorate, the Hon. John Lisenring as president, and Fisher Hayard, secretary. The erection of buildings and machinery will be at once commenced at Port Richmond, and the new fuel is promised for the market in December. The process consists in the addition to the coal waste of five per cent. of clay, the mass being moistened with a solution of lime in water. This mixture is fed to the hopper of a machine provided with compressing rolls containing cavities which are egg shaped and in which the lumps of compressed fuel are formed. The machines for use on a large scale will contain rolls three feet long with a total capacity of 100 tons per day. Although the fuel is ready for use on leaving the machine, and will not disintegrate in the fire or in handling, the inventor further treats it with a mixture of benzine and stearine, making it water-proof, and capable of exposure to the weather for any time. This feature of the process is not employed in Europe, where the manufacture of artificial fuel has been conducted for some years with success. It is, as seems probable, Mr. Lohse has perfected his process, the profit before him and the advantage to the country in the utilization of coal slack are enormous. The company includes several of our shrewdest business men, who propose to put the patent fuel on the market at \$1 per ton below the price of coal in lump.

The government, with a view to economy, has lately been disposing of some of the surplus iron-clads of the war, at our League Island Navy Yard. Last week a light draft monitor of 433 tons, was sold to a scrap dealer to be broken up. Two other iron-clads were also sold, one to Boston at \$23,000, and one to New York parties at \$20,000. Other condemned monitors are also to be disposed of shortly at the same yard, and offer a bargain to dealers in scrap iron.

The remarkable speed of the City of Peking, as noted in our report of the fastest steamer out of New York, which is no small claim. In smooth water, from Sandy Hook to Governor's Island, she made the distance, eighteen miles, in an hour and four minutes. On the Pacific, where, as a rule, the best steamer time is made, she will probably average near this in a sea way. It is another feather in the caps of the Delaware River shipbuilders to have launched in 1874 the two fastest steam vessels afloat.

The steel torpedo boat, *Erolite*, built by Neede & Levy, for the Egyptian government, made on her trial trip with a new engine never having steamed on before, as noted at the time, twenty miles in an hour.

The tendency to increased size in iron ships is noticeable the world over. From an average size of 811 tons, four years since, on the Clyde, the size has now been increased to an average of 1518 tons, with no proportionate increase of expense in running, but, of course, greater service profit. The screw has also, for ocean service, entirely replaced the paddle, and engines of 500 to 800 horse-power are now common in marine construction.

The railroads are not behind hand in progress. The Philadelphia, Wilmington and Baltimore Railroad Company are adding to their locomotives an improvement intended to greatly increase the safety of travel. This is an invention by which the engineer is enabled to have a full and perfect view of all the cars of the train behind him. To accomplish this the engine cab has attached a pipe extending through the roof, the opening of which is just before the engineer. In this pipe is placed a camera, which reflects the condition of the train, and enable the engineer to be always aware of it. The class of accidents due to the uncoupling or parting of trains should thus be avoided almost entirely.

While treating of new inventions I must not omit that of Mr. James Conney, Chief of the Boiler Department of the Baldwin Locomotive Works, which claims to offer increased safety in the construction of steam boilers by the use of a different shaped joint in caulking the seams. The account of the invention states that in tracing the line of fracture to the boiler seam, in cases of explosion, an objectionable inequality of thickness in the metal is always found, caused by the use of an angular caulking tool, which produces an indentation or groove on the surface of the underlying plate into which is forced a sharp lip of the upper plate. Upon this spot any unusual pressure will bend the plate, destroy the tissues of the metal, and produce fracture. To prevent this, Mr. Conney supplies a tool with a convex end, producing a smooth, concave indentation on the overlap plate, and greatly densifying the metal without injury to the lower plate. The Navy Department has appointed a Commission to examine the system at the Washington Navy Yard, and some very interesting experiments are shortly expected during the test. Anything which shall lessen the danger from boiler explosions is a general blessing, and this inventor comes from a school which has added much to mechanical improvement.

The Centennial progresses regularly. The latest movement of notice having been the action of the Board of Bank Presidents in relation to the formation of a bankers' department which shall collect, classify and exhibit suitable specimens of all coins and paper money of the colonies and the United States from the earliest settlement of the country to date, and also the statistics of banking and finance. The Treasury officials at Washington are co-operating in this, and the director of the Mint promises to aid in securing specimens of the principal standard coins of the world. In an historic and numismatic point of view, this will be an interesting display, but how much greater national curiosity and apprehension would the bankers' depart-

ment excite, if it would include in the show the novel specimen of the greenback at par! With this initial movement it is to be hoped that the proposed collection of American ores and coals will be made. The collection of iron ores was taken in hand by the Iron and Steel Association, which should be able to prepare such a display as no private combination could obtain. The subject has been lost sight of to the public, but will be doubtless cared for properly by the secretary of the Association, who, by the way, has just issued a very complete and convenient Directory of the Iron Works of the United States, in handy form, and giving the location, capacity and particulars of all the furnaces, rolling mills and bloomeries of the country.

A Look Ahead.

Our intelligent contemporary, *The Daily Bulletin*, says:

While the masses are grumbling about hard times, and fogies are predicting a return to the old time "hard pan," which is to ruin one-half the people, there is abundant evidence to intelligent eyes that we are even now entering upon an era of commercial activity surpassing anything known in the world's history. Nine men out of ten see nothing in the panic which broke upon this country one year ago but a reaction from excesses, political, social, commercial and financial; and they persistently insist that the reaction must be continued until the values of real estate, merchandise and labor are brought back to something approaching the ante-war standard. That the panic was a reaction from certain forms of extravagance may be readily conceded; but that the reaction will run to anything like the extent imagined by these "conservative" croakers there is not the slightest reason to believe.

There can be no doubt that, in this country, values generally have been in some measure inflated through various influences growing out of the war; and similar effects have resulted in Europe from the wars on the Continent. But these causes have become less potent each succeeding year, and they are by no means to be cited as a principal cause of the rise of commodities, real estate, rents and wages which has occurred here and in Europe within the last fifteen years. This universal change in values has arisen from deeper and more permanent causes. Steam and invention are the main factors in the revolution: steam, by introducing a new motive power; and invention, by providing machines through which the power can be applied to productive processes. In what ratio the productive power of society has been increased by the introduction of this new agent, we cannot precisely estimate. The result varies in different branches of industry, being least apparent in agriculture. But it would be safe to say that steam has already increased the production of Europe and the United States to double its former amount per head of population. Now, as this new motor and the varied machinery through which it works have to be controlled by labor, it results that, as a rule, labor as now employed turns out double the former amount of product, and that, therefore, it is worth so much more than its former value. Here, then, is a cause for the advance in wages which lies deep in the roots of society, and which cannot cease to produce its present effect on wages so long as these new conditions continue operative. It would be well for those who are expecting wages to be brought down to the old level, and who maintain that we can have no real prosperity until such a reaction is completed, to ponder seriously these new conditions affecting labor. The same causes that produce this advance in wages produce also a general increase of expenditures, family, trade, and even governmental. We recently demonstrated, from authentic statistics of the foreign trade of all the commercial nations, that the commerce of the world had been doubled per head of population within the last fifteen years, which, of course, lays the basis for an increase of rents and trade outlays at all the business centers; and this vast expansion of business is to be accounted for from the new appliances of steam-power.

The proper subject of inquiry, at the present juncture, therefore, is not whether the commercial reaction through which we have been passing for a year will carry us back to the old values—that is a thing that no reflective man will ever dream of—but rather what are to be the future effects of the revolution in industry and trade which steam has introduced? It would be a mistake to suppose that the process in the direction we have indicated has already been worked out. Even in those countries where machinery has been most generally applied, there yet remains much to be done. Every day labor-saving appliances are being introduced and production more and more facilitated; and no one can deny that, for the next ten years, the improvements in productive processes, in such countries as England, France, Germany and the United States, may not be as important in their bearing on trade and labor as those introduced within the last decade. The really important matter, however, and one about which there is no uncertainty, is that there are vast masses of even civilized population among whom steam has yet scarcely been introduced. To say nothing of the South American States and Mexico, with their forty millions of population, even Russia and Hungary are comparatively without railroads; and much less have these countries learnt to employ steam in their various manufacturing processes. China, with 450,000,000 of population, India with 190,000,000, Turkey with 42,000,000 and Japan with 35,000,000 have scarcely begun to use internal steam transportation; and yet all these countries are showing a marked inclination to encourage its introduction. Virtually, there is 850,000,000 of the world's population awaiting the introduction of steam, first in its application to transportation, and subsequently to more general uses. The effect of this inroad upon the hitherto exclusive nationalities is to be the great stimulant of commerce for coming years. We do

not so much allude to the stimulus that may arise from the commercial countries being engaged to construct railways in the less civilized nations—although that will be most important in its bearing on the activity of business—but to the vast increase of commerce that must come from these enormous populations being thereby made open to a freer exchange of commodities with other nations. It is as true of China or of India as it is of the United States, that the opening of a railroad stimulates industrial activity along its whole route, and enables a vast amount of products to be exchanged which would otherwise remain at home. The appliances of steam in the more highly civilized countries has qualified them for supplying those less civilized with a thousand articles which could be exchanged with great mutual advantage; and when the railroad has once penetrated these backward populations, nothing can prevent a vast trade growing up as the consequence. No one acquainted with the awakening of the commercial spirit in Russia, India and Japan can doubt that within the next ten years we shall witness a very large increase in their foreign trade; and the same may be expected, in a more limited degree, from China and Turkey; although a very active development of trade with the latter countries may be reserved for a decade later.

We are already entering upon this era of renewed activity, although the beginnings may, as yet be scarcely perceptible; and it becomes our merchants to be on the lookout for whatever chances this new drift of commercial enterprise may foreshadow. It is worth the while of our iron trade to consider where the iron is to come from for building the railroads for these vast populations which have hitherto done without them. Much as the English iron trade has suffered, yet the shipments of railroad iron from Great Britain, for the first seven months of this year, have been 505,164 tons against 435,550 tons for the same time of last year, and the following statement of exports for that period shows the countries which have mainly contributed to this increase:

	1873.	1874.
Tons.	Tons.	Tons.
To Russia.....	69,004	92,562
Sweden and Norway.....	83,302	48,571
Spain.....	7,159	14,332
Egypt.....	3,190	17,042
Brazil.....	6,109	14,300
China.....	3,240	11,653
British India.....	9,848	27,908
Australia.....	11,009	45,221

These figures plainly show that, while the shipments of iron to the more advanced countries have declined, there has been a large increase in those to the more backward nations; confirming what we have above stated, that we are entering upon an era of railway construction among those large populations which have hitherto failed to avail themselves of the developing power of steam. It is only necessary to consider how much railroads have done for the leading commercial nations within the last fifteen years in order to judge how far such a development may follow this new drift of railroad construction. Putting together all these considerations, we feel justified in concluding that, while our merchants are folding their hands and grumbling, we are closely verging on an era of commercial activity unequalled in the annals of trade.

Drainage for Health.

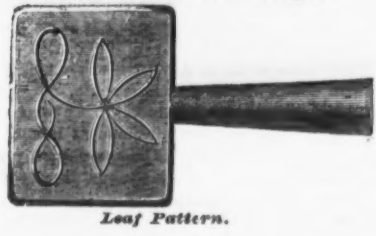
The proper drainage for buildings is a matter of importance. Cellars may be wet, stables not very dry, water may drip from the eaves, cutting holes into the earth and making puddles. The water from such puddles filters directly into the cellar, so that old houses in the country are very frequently dangerous to life on account of the water settling into the cellars. A damp cellar may sometimes be made dry by making a sink in it. Cellars are sometimes made in such wretched places that they need drain pipes to carry off the water. In arranging any of this kind of work about a stable, it is necessary to be careful that the drainings of the stable do not filter into any water required for domestic use. Water should on no account be allowed to drip from the eaves; it is a great nuisance, undermining foundations and rapidly destroying buildings.

Air confined anywhere, even in a clean room, becomes offensive, probably unhealthy, with a disagreeable smell of closeness, and confined with filth in a drain or sewer, it must be infinitely worse. Drains built tight, with traps, etc., so that there is no ventilation of their interior, generate very poisonous gases, which are ready on the occurrence of any small leak to escape and poison everybody who happens to go near them. The best arrangement for ventilators in houses is to have a separate flue built in the chimney stack expressly to receive the ventilator pipes. Thus the air from the drain is discharged high in the atmosphere in a position to be mixed with smoke; and the noxious properties are destroyed, the smoke, whether of wood or coal, containing about the best chemical disinfectants known.

In all parts of New England hundreds of people are dying every year of typhoid fever. A large tract of the city of Boston is now building on made land, nearly as flat as the prairies about Chicago; and in a few years it will doubtless have to be regraded and rebuilt to get rid of this pestilence. From Maine to Pennsylvania there are flat, undrained fields, and wet cellars nearly as bad. All over the country further South, but principally in the Mississippi Valley and the flat country bordering the ocean, the half drained land is infested with intermittent fever and other malarial pestilences to such an extent as to destroy many thousands of people every year; so that, in spite of constant immigration, extensive tracts of country are about as sparsely settled as they were when Pocahontas saved the life of John Smith.—Dr. Joseph Wilson.

H. D. SMITH & CO., PLANTSVILLE, CONN.

Patent Embossed Steps.



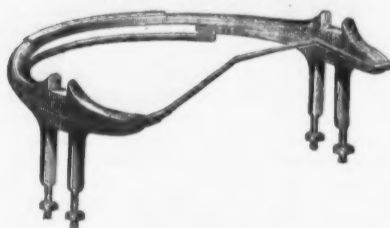
Leaf Pattern.

King Bolt Yokes.

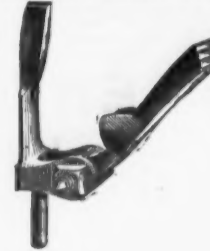


Established 1850.

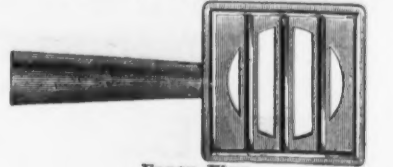
No. 6 Fifth Wheels.



1871 Pattern Shaft Couplings.



Patent Cross Bar Steps.

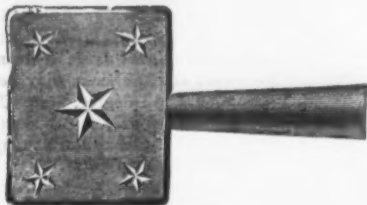
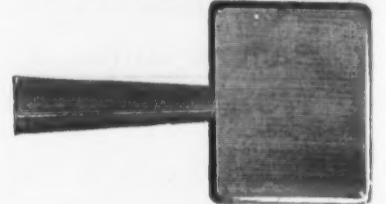


Upper View.



Lower View.

Solid Plain Pattern Steps.



Star Pattern.

Smith's Improved Philadelphia Pattern Slat Irons.



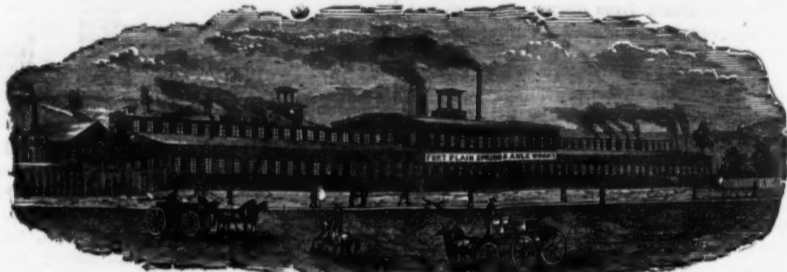
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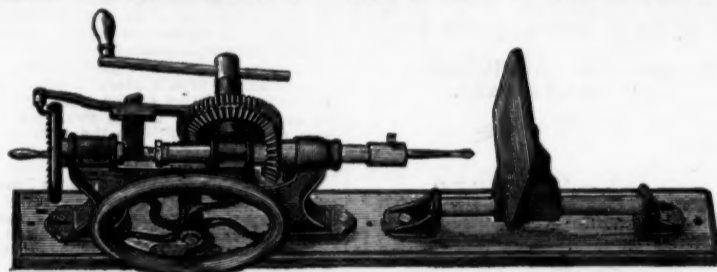
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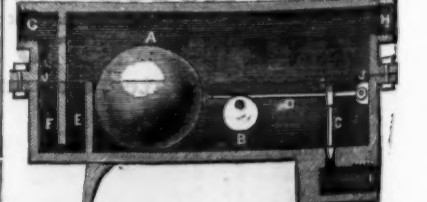
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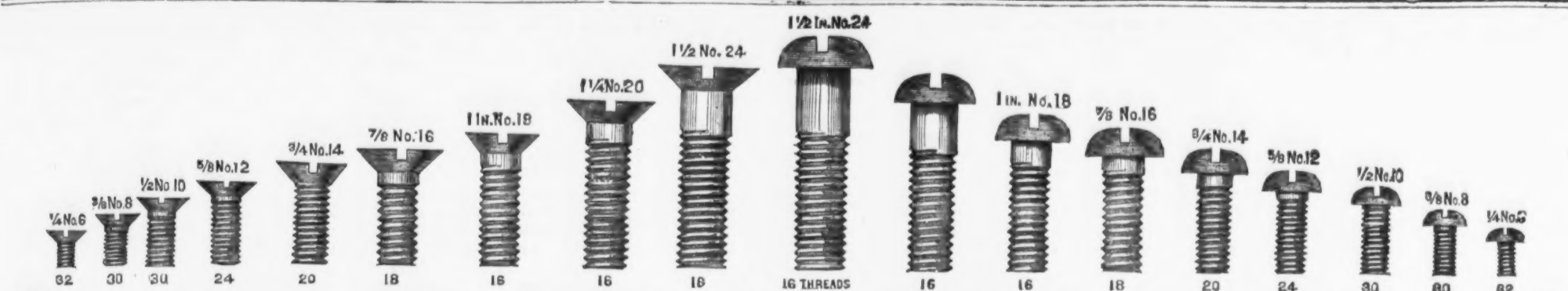
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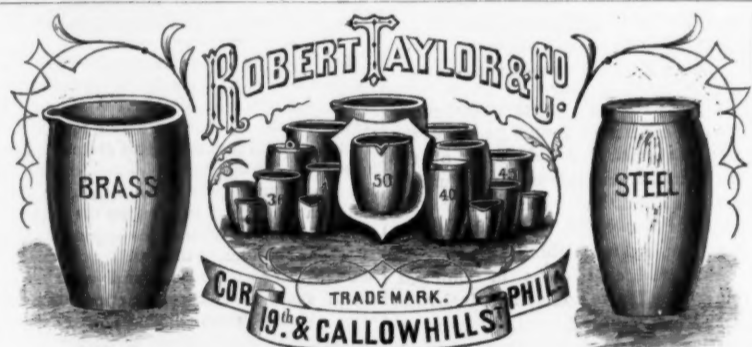
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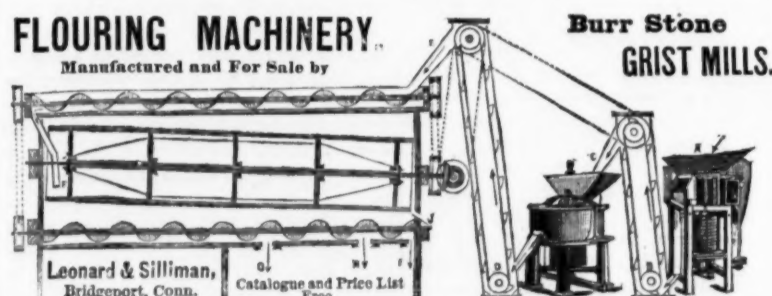
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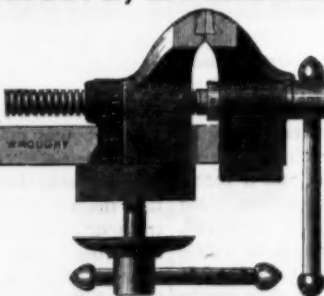
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JAMES C. BAYLES . . . Editor.
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Defects in Iron Construction.

The architectural iron business has, to a great extent, been developed since the beginning of the late war. The increase at that time in the wages of stonecutters gave iron construction the precedence over stone in point of economy, and many persons then engaged in the business. A sharp competition arose which resulted in effecting a reduction in prices, and in introducing many improvements and simplifications in foundry operations and the general manipulation of both cast and wrought iron. Another result, not so desirable, however, has arisen from this competition, viz., the introduction of bad workmanship into the business. Whether this has been due to carelessness or design, the ulterior cause has been the same. Faulty construction at length became so common that a voluminous restrictive law, a large portion of which related to iron construction, was passed by the New York legislature. The most important provision of the law was the appointment of an inspector for the purpose of testing all beams, girders and lintels before placing them in their position in the building. The necessity of this provision was afterwards shown by the fact that, of 1787

lintels, beams and girders tested from the organization of the department to the end of 1872, 31 were found to be insufficient to bear the strain to be imposed upon them, and 15 actually broke during the test. Each of these defective pieces would probably have occasioned some accident had it been placed in its destined position. In *The Iron Age* of May 7th it was stated that an arch girder with a wrought iron tie rod used in a building in 180 Laurens street, New York, was found to have deflected $\frac{3}{4}$ of an inch, and would probably have broken but for the prompt use of an intermediate support. An arch girder designed for a building in Sixth avenue, having a $2\frac{1}{2}$ round tension rod, and estimated to sustain 59 tons, gave way at a pressure of 12 tons on account of an imperfect weld in the rod. The latter should have stood a tensile strain of 117 tons. During the test of another arch girder, intended to sustain 24 tons, with a tension rod computed to sustain a strain of 72 tons, the rod parted at a pressure of 2 tons, owing to an imperfect weld. In Sixth avenue a cast iron beam broke after being actually laid in position; the wall, however, was prevented from falling by a brick arch which lay directly over the beam. On the corner of Third avenue and One-hundred-and-third street, two lintels, which were supporting the front walls of two buildings, broke, and had to be replaced by stronger ones. During a period of twenty months it was found that in about twenty places, beams, lintels and girders had seriously deflected, requiring the placing of intermediate supports between the spans of the openings.

A practice common among iron builders is known as skinning the columns. If a specification calls for a column of a certain thickness of metal, it is the custom of the founder to make it of that thickness at the ends, but at a few inches from the ends to materially reduce the thickness. Thus he effects a saving of metal. Until recently there was no means of detecting this fraud except by boring holes through the metal, which was an expensive operation, impairing the strength of the iron. The inspector of iron construction in New York has recently made a pair of callipers 10 feet long, constructed so that one arm can be thrust inside of the column, and the thickness at any point determined. The arms of the callipers are extended so that the thickness of the metal may be seen without withdrawing the instrument from the column.

A few months ago a concurrence of defects in construction brought about a sudden disaster. A large ice house for the cooling of liquors fell to the ground a mass of ruins. The prime cause of the disaster was probably the settling of the foundations of some of the columns. The building was sustained by three rows of columns, each column resting on a base of blue stone. The bases beneath some of the columns in the two exterior rows settled slightly, causing a settlement, also, of the columns resting upon them. Such an action, of course, produced a strain upon the center row of columns, tending to split or tear the columns asunder. The settlement of the foundations had been suspected before, and its evil effects could have been prevented had the iron work been properly constructed. The columns, however, had been skinned, and instead of the metal being $1\frac{1}{2}$ inches thick, as called for in the specification, it was only $\frac{3}{4}$ inch thick. Many of the columns in the center row, therefore, when the strain came upon them, split for a considerable distance down from the top, the whole building caved slowly in, and by 10 o'clock in the evening was a perfect wreck. A further deviation had been made from the terms of the specification in the construction of the columns. The latter should have been cast with a broad, square flange or plate at the top, upon which was to rest another plate supporting the girders of the building, and the box supporting the column above. The plate, however, was not cast upon the column. The top of the column was, therefore, round, and the plate supporting the box was square and projected a considerable distance beyond the top of the column. The pressure of the sides of the box upon the plate caused the two sides of the latter to act as levers tending to tear the columns asunder, as actually occurred. A similar accident was prevented in the large ice house in Ninety-second street by a timely discovery when the plates above the capitals of the columns had already begun to crack. In this case the defects were different from those which were the cause of the accident just described. In the top of the plate over each column on which the girders rested was cast a recess intended to receive a wrought iron plate to which the girders were to be bolted. The thickness of the plate was to be a little greater than the depth of the recess in which it was placed. Its purpose was to keep the columns perfectly upright, the wrought iron piece being firmly bolted preventing the columns from swaying to

one side or the other. Also, if by reason of a great weight in the building the girders should be deflected, their weight would not come upon the edge of the plate over the capital so as to create a leverage, but would rest directly on the center of the column, the piece being higher than the recess and preventing the girder from touching the edge of the plate in which the recess was cast. The recesses were cast in the plates, but the wrought iron plates were not put in. The weight, therefore, came upon the exterior of the plates over the capitals, and tended to tear them asunder. The cracks, however, were discovered in time, the injury was repaired and the recesses filled with a composition metal. It should be remarked that a number of ice houses designed by the same architect are standing, and are apparently as sound as ever. The trouble in the cases alluded to was not in the plan but in the construction.

We mention these facts, not with any desire to weaken public confidence in the value of iron as a material of architectural construction, but in the hope of impressing upon the minds of those engaged in the business that the practices to which we have called attention are well calculated to inspire the public with a distrust of their work, and to bring iron buildings into disrepute. We are willing to make all due allowance for the embarrassments which honest founders suffer because of the sharp competition to which they are exposed—vastly more allowance, indeed, than they could expect from the public at large. We know that iron builders are often required to figure below the cost of good work to secure for their bids a moment's consideration, and that it is desirable a builder should make a profit upon his work whether the price he gets for it be high or low. At the same time it is necessary that respectable builders should make a vigorous stand against the measures commonly resorted to by cheap contractors. Public confidence is easily shaken, and the fall of one iron building, or its condemnation as insecure, would do more mischief to the interest of this important branch of business than could be undone in years. No builder will confess to bad or rascally workmanship, and the blame is easily shifted upon the material, which suffers accordingly in the public estimation. Those who order work should be made to understand that an iron building is never cheap which costs less than the value of good materials and first-class workmanship, and the best way in which to draw the line is for respectable builders with reputations to lose to refuse contracts which can only be filled without loss by a recourse to discreditable practices, that can only result in injury to the business.

The Wisconsin Railroad Law Sustained.

It is, at least, a satisfaction to know that the "railroad war" in the West is approaching an issue which will at least enable the parties to the contest to understand each other better than they seem to do at present. The Wisconsin Supreme Court has affirmed the constitutionality of the Potter railroad law, and sustained the injunction, granted by the courts below, to compel compliance with its provisions on the part of the Chicago & Northwestern, and the Chicago, Milwaukee & St. Paul Railroads. This is bad news. It means that the State has power to impose upon its great lines of inter-state communication conditions and restrictions which will cause capital to shrink from investment in such enterprises, and indefinitely postpone the attainment of cheap transportation through the multiplication of competing lines. For the sake of many interests, all more important, as affecting the general welfare, than those which the Granges are supposed to represent and champion, we regret this decision. It gives a loose rein to the Legislature of Wisconsin, which may now be expected to pursue its advantage with relentless purpose, and it places the interests of those who have invested their capital in the building of railroads at the mercy of bodies of men not always representing the intelligence of the communities from which they come, who may chance to be elected for brief terms of legislative service. If this decision is sustained by the United States Supreme Court, the States which have seen fit to enact restrictive laws may be dropped, for the time, from the list of those in which a sustained railway progress may be expected, and the roads legislated against may derive such satisfaction as they can from the knowledge that the clamor of the Granges for cheap transportation will, while it lasts, effectually protect them against the only danger which they really fear—competition through the increase of transportation facilities.

It is certainly to be hoped that the Granges, and those who manipulate legis-

lation in their interest, will before long reach a correct understanding of the nature of the problem with which they are attempting to deal. They now propose to secure cheap transportation by the simple expedient of enacting laws arbitrarily fixing the rates which the railroads are permitted to charge for the carrying of freights. Evidently they do not see the consequences of such a policy; but it is still more evident that they are ignorant of the obvious fact that their interests will be promoted far more by doing away with the necessity for the transportation of their products than by making transportation cheap by means which will tend to drive capital away from railroad investments. It is folly to suppose that such a commodity as grain can bear the cost of long transportation to Eastern and foreign markets, and return to the producer any considerable part of the price which the distant consumer is required to pay for it. If it takes three or four bushels of grain to carry one bushel to market, the farmer must calculate his profits accordingly. What the Western farmers need is a home market, and this they will soon secure by a course which will promote to the fullest extent the development of the natural, industrial and commercial resources of their respective States, which is in a marked degree dependent, first, upon the maintenance of the system of protection to home industry, and, second, upon the multiplication of railroads. For all they have, and are, the Western States must thank those who ventured the construction of railroads into new and undeveloped sections of country, on the faith of a future traffic which did not then exist, and which depended for its existence upon an immigration which the railroads invited. They are not yet in a position—and, indeed, never will be—to set their heel upon the railroad interest and declare themselves henceforth independent of the benefits it has conferred upon them. The future of the West is peculiarly dependent upon the largest and most rapid development of our railroad system, and whatever legislation tends to defeat this result will heavily react upon the States which venture such rash experiments in law making.

The Exhibition Season.

The increase in the number of industrial expositions held in different parts of the country is a gratifying indication of the growth of a popular interest in industrial progress. In addition to the regular State and county fairs, which are gradually assuming more and more this character, we have industrial exhibitions in Chicago, Cincinnati, St. Louis, Louisville, Nashville, Newark, New York, Boston, and several other cities. Those of the principal Western capitals are said to be unusually well patronized by exhibitors this year, and from accounts which reach us we conclude that the public are equally interested, since large crowds are in daily and nightly attendance. In Newark the exhibition is limited to local industries, and, to some extent, the interest in it is local also. The venerable American Institute, which is now conducting its annual fair in this city, is not, perhaps, a true representative of metropolitan enterprise, and its exhibitions are not as entirely satisfactory as we could wish. In Boston the Mechanics' Institute and in Philadelphia the Franklin Institute are doing good work in the same field, and the last named institution promises to make a showing which will be worth going a long distance to see. With these facilities open to them, manufacturers have every inducement to compete for honors and business, and we are glad to see that they are very generally making good use of their opportunities. The money expended in exhibiting goods from year to year is well invested, and those who have anything worth showing to the public cannot do better than to show it whenever a chance presents itself.

On recommendation of Mr. Bristow, the President has appointed Mr. Wm. Burnett, of Boston, to the office of Supervising Inspector General of Steamboats. Mr. Burnett has our sympathies. We do not question his eminent qualifications as an engineer, but we fear he will share the fate of Smith and his unhappy predecessors when the next steamboat boiler explosion shall reveal the fact that he was unable to prevent it. The system which Mr. Burnett is appointed to carry out is a very pretty one on paper, and the knowledge that it exists is calculated to allay the apprehensions of nervous old ladies making steamboat journeys, but there its practical usefulness ends. If the Treasury department would use its influence to secure the enactment of a code of simple laws making steamboat owners responsible for the safety of life and property committed to their care, and then employ its power to enforce those laws with rigid impartiality, leaving the steamboat owners, in the mean time, at liberty to adopt whatever precautions of safety they

might deem best, we should have a genuine reform. As it is now the government assumes the responsibility, and by a nominal compliance with the letter of certain Treasury regulations, the steamboat owners are safe against the consequences of any violation of its spirit.

New Publications.

THE IRON WORKS OF THE UNITED STATES. A Directory of the Furnaces, Rolling Mills, Steel Works, Forges and Bloomeries in every State. Prepared by The American Iron and Steel Association, No. 265 South Fourth street, Philadelphia, 1874.

This valuable work of reference, compiled by Mr. James M. Swank, Secretary of the American Iron and Steel Association, ably assisted by Mr. George H. Cope, will prove of great value for many purposes. It is a complete directory of those branches of the American iron trade which are mentioned on its title page. Under its present organization the Iron and Steel Association is doing good service, and this little volume is one of the results of the varied labors of its secretary during the past year. In its pages will be found mention of 681 completed blast furnaces, 343 rolling mills, 51 steel works, 37 forges and 47 bloomeries. Of the rolling mills 84 make rails. Of this number 62 make heavy sections, including 8 finished Bessemer works and 2 which are adding converters to their plant. The work is sufficiently accurate for the purpose for which it was intended, and is certainly free from grave errors and important omissions. It gives evidence of careful and conscientious preparation on every page, and when meager information is given, the reason for it is found in the unwillingness of the proprietors of iron works to give the desired information. The contents of the volume are well arranged and well indexed, and such information as it gives is easily accessible.

MANUAL OF PATENT LAW, with an Appendix upon the Sale of Patents, by Wm. Edgar Simonds, Counsellor in Patent Causes. Hartford, 1874.

The little volume is of great interest to manufacturers and inventors, being a condensed popular treatise on the principles of patent law, based upon United States statutes as interpreted by the courts. The language is free from legal technicalities, and a careful reading of its well filled pages will give those for whom the subject has interest a very clear and correct idea of the rights, duties and obligations of inventors and patentees. From the abstract of this volume, which appears in this and previous issues of this journal, our readers may gain a very correct idea of its scope and purpose. The book is full of useful information, and we commend it to the manufacturing public.

Railway Service Reform.—The following excellent rule is hereafter to be enforced on the Lake Shore and Michigan Southern Railway: "Notice is hereby given to employees connected with the running of trains that they must make themselves perfectly familiar with the general rules printed upon the time tables, and with the special rules upon the time table of the division where they are employed. Hereafter no promotion to the position of conductor or of engineer will be made until after the candidate shall have been examined as to his knowledge and understanding of these rules by an examining board, whose certificate of qualification he must receive. The board of examination for conductors will consist of the superintendent of the division upon which the candidate is to be employed, assisted by at least one, and, if practicable, two, other superintendents of divisions. When a candidate for the position of engineer is to be examined, the board will consist of the superintendent of division, the master mechanic of the division, and, when possible, of another superintendent or master mechanic, who shall be requested by the division superintendent to sit with them. The candidate's certificate must receive the signature of all the members of the board, else his appointment will not be confirmed. The certificate must be approved, in the case of an engineer, by the general master mechanic, and in that of a conductor by the general superintendent. Proper forms for such certificates will be prepared and supplied to the superintendents of divisions. Those conductors and engineers who are now in the service will be required to pass an examination before a board similar to that designated for candidates as the convenience of the superintendent of the division will permit; and such as may prove deficient in a knowledge and comprehension of the general and special rules will be suspended from the service until they shall be found qualified to receive a certificate."

The Lake Superior Iron Product.—The following table will show the total shipments in gross tons from the Lake Superior iron district for the season of 1874, up to September 3:

IRON ORE.	
From Marquette.....	305,045
From Escanaba.....	185,643
From L'Anse.....	58,300
Total.....	548,988
PIG IRON.	
From Marquette.....	15,154
From Escanaba.....	9,433
From Grand Island.....	4,355
Total.....	32,433

The Swedish Mining Company at their last general meeting voted considerable sums as subsidies toward the further development of the mineral interests of the country, among which may be mentioned an augmentation of their annual contribution to the school of mining at Falun and Philipstad—25,000 kronen for a testing machine for iron and steel, to be erected at Stockholm, 100,000 kronen for the purchase of a boring apparatus, and 25,000 kronen in aid of the fund for securing a worthy representation of the industry and produce of Sweden at the great Centenary exhibition in 1876 at Philadelphia.

Metallurgical Technology.

We condense the following from the able report of Mr. David Forbes, published in the proceedings of the British Iron and Steel Institute, vol. 1, 1874, just received:

Texture of Iron.—In the *Annales des Mines*, No. 1 for 1874, pp. 90-108, there is a paper, entitled "Recherches sur la Texture du Fer," by M. Janoyer, director of iron forges, the object of which is to prove that the so long employed classification of irons into those which have a granular, fibrous, or mixed fibro granular texture, is founded on erroneous suppositions, and that the only texture really inherent or characteristic of iron is the granular, the other varieties being entirely due to imperfect welding in the manufacture of the iron. This conclusion he arrives at from a study of the results obtained in the different modes of manufacture, and the microscopic structure of the irons so produced. Considering the intimate relations which exist between the physical properties of the iron and the state of the welding of its mass, he remarks, on the subject of density—that, as might a priori be expected, granular iron being more perfectly welded, is naturally more compact and homogeneous than fibrous iron, and may be considered to vary in density from 7.780 to 7.791, whereas, the specific gravity of fibrous iron is not higher than from 7.760 to 7.751. As regards hardness, he agrees with the old assertion of Karsten, that the better the iron the harder it is, and that the best iron shows a pure silvery granular fracture, which is the type of a thoroughly welded iron, one in which no interposed foreign matter can be perceived, nor any solution of continuity detected. With respect to tenacity, this must be looked at from three aspects, i. e., resistance to traction, to compression, or to flexion. Granular iron being welded throughout its entire mass must necessarily be that which offers most resistance to traction and compression, as, in equal sections, the surfaces to be separated are greater than in the case of fibrous iron. On the other hand, however, fibrous iron, as it allows the particles of the bar to approach still closer to one another before the moment of fracture, is more flexible, although less elastic, than granular iron. As to malleability or the property of extension under the hammer, this is more developed in soft, i. e., fibrous or non-welded iron than in the harder granular iron; and, lastly, as to ductility or the property of being drawn into wire more or less fine without breaking, this depends on two conditions, viz., that the iron is at the same time sufficiently homogeneous in order to pass through the hole in the drawing plate, and tenacious to support the traction. For these purposes hard iron, or that in which the grains are perfectly welded to one another, is the only proper material, as fibrous iron, from its not being perfectly welded, is not sufficiently homogeneous, and consequently is liable to break off at any moment.

According to M. Janoyer, the influence exerted by sulphur and phosphorus on the texture of iron is totally different, the former having the tendency to produce fibrous or badly welded, whilst the latter does not interfere with the welding, and results generally in granular iron.

At the end of this paper are appended some observations by Professor Gruner, in which that gentleman, although agreeing in the main with this result of M. Janoyer's researches, remarks that he appears to confuse fracture with texture. The fracture of a bar of iron does not necessarily represent its normal texture, and can present a very different appearance in the same bar of iron according as it is effected by a sudden violent shock or by a slow and gradual flexure.

Dephosphorizing Iron Ores.—In several of the foreign reports, allusions have been made to Jacob's process for dephosphorizing the iron ores previous to their being smelted in the blast furnace by treatment with a solution of sulphurous acid, and as the author of this report had, in June, an opportunity, through the kindness of Director Jacobi, of inspecting this process in operation on a large scale at the Adalbert Iron Works, at Klado, in Bohemia, it is here proposed to give a sketch of the process as there carried on: The iron ores thus treated are found in the Lower Silurian formation, as a bed some fifty feet in thickness, and are of a dark blackish gray color, with frequently traces of a psilotic structure, and often containing particles of magnetite. They are in appearance altogether identical with the iron ores which are found inter-stratified with the Llandovery beds on the west side of Cader Idris, in Wales, near Dolgelly, and seem also to be of much the same chemical composition. The ores at Klado are first roasted in small round kilns, after which they are placed in tanks; those at the Adalbert Works contained, in all, about four thousand tons of ore, in which they are submitted for some time to the action of water containing sulphurous acid (which is made by burning ordinary iron pyrites and condensing the acid fumes with water in two towers). The result of this is that a solution is obtained which contains the major part of the phosphoric acid present in the ore (from 3 to 3.3 per cent.) in the form of phosphate of alumina, which, when drawn off, leaves the ore in a comparative state of purity, i. e., almost free from sulphur, which is also removed by the calcination and subsequent working, and with only from 0.28 to 0.4 per cent. phosphoric acid, so as to be suitable for making excellent rails, girders, and bar iron, for which, before this treatment, it was altogether unfitted. Taking advantage of the property which such a solution of phosphate of alumina in sulphurous acid has, of again depositing the dissolved phosphate of alumina, upon merely boiling and so expelling the sulphurous acid; the solution, when drawn off from the iron ore, is passed through a coil of iron pipes heated in a furnace, and allowed

whilst boiling, to run into settling tanks, in which the phosphate of alumina deposits itself, and from which (after draining off the supernatant water) it is removed and dried, in which state it is sold as manure, for which purpose it is eagerly purchased, as it has proved to be an excellent fertilizing agent. According to Herr Jacobi, in the air-dried state in which it is sold, as a soft, chalky-white powder, it contains from 30 to 33 per cent. phosphoric acid, 26 to 33 per cent. alumina, 8 to 10 per cent. sulphuric acid, 2 to 3½ per cent. silica, 30 to 25 per cent. water, and, strange enough, only from 1 to 2 per cent. oxide of iron, the iron in the ore being all but unattacked by the solution of sulphurous acid. During the boiling operation, the sulphurous acid, which is given off in the pipes, is reconducted to the condensing towers, and thus is made use of again and again. As, according to Herr Jacobi, the sale of the phosphate of alumina covers the entire expenses of the process, it seems highly probable that it might pay to use this process for purifying Welsh ores, since they contain from 38 to 51 per cent. metallic iron, and can be mined at a very cheap rate.

Calcination of Native Oxides of Iron.—In Sweden, and most other countries where iron is smelted with charcoal, the universal practice, from the most ancient times, has been to subject the nearly pure native magnetic and specular oxides of iron to a preliminary calcination before charging them into the blast furnace—the reasons for so doing, if we except the statement that in practice it has been found better, have been variously given, and metallurgists generally are not agreed as to the true explanation as to why this preliminary calcination should be necessary. The results of an experimental inquiry into this subject have recently been published by M. H. Tholander in the 1st and 2d numbers of *Jernkontoret's Annaler* for this year, which, however, have reached us too late to prepare an abstract for this present report.

Smelting Iron Ores with Lignite.—This is a very important question in countries in which the coal is of recent age and not suitable for coke making, as most of the carboniferous formation coal is. It has attracted special attention in Austria, and the first part of a communication on the subject, by Dr. von Reichenbach, of Vienna, which gives a history of the different experiments that have been already tried in this direction, will be found in the *Berg u. Huettenmaennische Zeitung*, for June 12, 1874. Until, however, the whole of this paper has been published, we abstain from attempting an abstract.

Introducing Gases into Blast Furnaces.—A patent has been taken out in this country, No. 3843, dated November 25, 1873, which is a communication from E. Andre, of Wetzlar, in Nassau, for an arrangement by which carbonic oxide or other combustible gas can be introduced into furnaces, or rather sucked in by the force of the blast through a tube placed like an injector within the water tuyeres. There is little doubt of this arrangement succeeding, but it is another question as to whether there can be a corresponding advantage gained by using the gases in this manner.

Casting from Blast Furnaces or Cupolas.—The question as to whether castings, made direct from the blast furnace, are as strong and good in quality as when the same iron is remelted in the cupola, is in many Continental countries it is made a special condition "the castings to be from the cupola," has been often investigated, and is the subject of a paper by A. Ledebur, in the *Berg und Huettenmaennische Zeitung*, for January 9th, 1874. The experiments cited in this communication appear to prove that the same iron, after remelting in a cupola, is not so strong as it was originally when cast direct from the blast furnace, and leads to the conclusion that the insisting upon the iron being cast from the cupola is no guarantee for its being of better quality—and often may be the reverse—but that a great deal depends upon the class of ores and fuel used in the blast furnace, and the mode in which the smelting is conducted. In the charcoal furnaces in Sweden and Norway, when extra strong castings are required, they are always cast direct from the blast furnace, although this is not done where fineness of casting or ornament is to be attended to.

Puddling Iron.—An interesting paper, entitled "Observations pratiques sur le Puddlage," by J. Wolters, of the forges of the Societe Anonyme de la Providence, is published in the first No. of the *Annuaire de l'Association des Ingenieurs sortis de l'Ecole de Liege*, p. 34, which, as it is also reproduced in the *Revue Universelle des Mines*, will most probably appear in the English edition of that journal.

From Belgium, we learn that M. Masion, one of the managers of the rolling mills of La Renaissance, at Louvroil, has taken out a patent for a furnace for puddling and reheating upon a new system, by which, according to the inventor, a saving of from 30 to 40 per cent. fuel is to be effected; as yet, however, we have not received any particulars of this invention.

Alloys of Iron.—A patent, No. 3347, dated October 7, 1873, for the "Treatment and compounding of cast iron with other metals or materials," being a communication from W. M. Arnold, of New York, U. S., claims the alloying of cast iron in its molten state with copper, tin, zinc, manganese, and antimony, the compound metals being melted in a crucible, and added to the cast iron in a molten state. The best proportions for common gray iron are stated to be: copper, 1 lb.; tin, ½ lb.; zinc, 3 lbs.; manganese, ½ lb.; antimony for hardening without chilling, ¼ to ½ lb. to each hundred pounds of iron. The result is stated to be that of "removing the oxides, sulphur, and phosphorus, and reducing the carbon, electrifying and galvanizing the iron in a molten state"—what the latter expressions mean it is difficult to say.

Another patent, No. 3365, dated October 9,

1873, is a claim by M. S. L. Delatol, of Paris, for alloying iron and steel with nickel or cobalt, or a mixture of both metals in certain proportions, by which it is asserted that the product is rendered proof against rusting on exposure to the atmosphere, water, or other oxidizing influences, and it is further stated that cast iron so alloyed can be converted into wrought iron or steel by the usual methods.

Bessemer Steel.—To prevent the formation of cracks in larger castings, especially in Bessemer steel ingots, Herr von Eberworth recommends casting the ingots at the lowest possible temperature, for which purpose he advises the opening through which the metal is poured into the mold to be very small, so that the operation may be protracted as long as possible—where the metal in the converter is very hot and liquid this may be advisable, but, in Sweden, where this is not the case, it is found necessary to lose no time in filling the ingots in order to prevent the solidification of the steel itself in the pouring ladles.

Phosphureted Steel.—Great excitement was manifested generally on the Continent by the announcement published in the *Bulletin du Comité des forges de France*, that the great problem of the manufacture of steel from cast irons containing phosphorus, had been at last solved at the Terre Noire Works, and at the meeting of the Societe des Ingenieurs Civils, of the 20th February, the president, Professor Jordan, called upon M. Euverte, the manager of the Terre Noire Works, to communicate the results which had been obtained in this direction. After some introductory remarks tracing the improvement generally introduced into the practice of the Bessemer process, he directed attention to the superior results obtained by the substitution of ferro-manganese for spegeleisen (some of which were published in the *Journal* of the Institute by the late Mr. Kohn), and then to experiments made by M. de Wendel, on a large scale, at Hayange, to test the possibility of making steel from the ores of the extensive mineral deposits of the Moselle, notwithstanding their containing a high percentage of phosphorus. The experimental pig iron, first puddled with great care, was melted down in a Siemens-Martin furnace, and the ingots then sent to Terre Noire to be rolled into steel rails, and, although not entirely successful, these results were so encouraging as to show that the object was not impossible of attainment, and led to other more decisive trials being made. For some years past M. Tessie du Motay had also been making experiments on the same subject at Commines, which experiments were also transferred to Terre Noire for further prosecution. The results of the united experiments showed that, although it was not possible to eliminate the phosphorus in any rapid process like that of Bessemer, it was possible, under certain determined circumstances, to allow the phosphorus to remain in the steel without having any injurious effect upon its qualities—and it was proved that even with tolerably large amounts of phosphorus introduced into the steel in a Siemens-Martin furnace, the operation when completed by the addition of ferro-manganese (containing 42 per cent. of metallic manganese) yielded a malleable steel of good merchantable quality, and a repetition of such experiments elicited the conclusion that—"phosphorus may be introduced into cast steel provided the carbon be eliminated; and the less carbon there remains, the more phosphorus may be left."

The practical experience already acquired at the Terre Noire Works proves, according to M. Euverte, that a steel containing about three thousandths parts of phosphorus with one-and-a-half thousandths part of carbon is very malleable and fit for making rails of good quality, but as yet the precise quantities of phosphorus and carbon which can be present at the same time in steel of good quality has not been definitely determined.

M. Euverte alluded to the great future of this discovery, especially pointing out that there were at least some thirty millions of bad iron rails now in the world, which could be converted into cast steel rails. The mode of manufacturing the ferro-manganese employed at Terre Noire has already been given in our last foreign report, and it is stated that its cost price is about 1/6 per lb., while the addition of only 2 per cent. of it to the bath of steel is quite sufficient to effect the desired transformation.

As a discovery, the principle enunciated here is not new (it was held by the late Mr. Matthiessen), and steels containing phosphorus have years ago been manufactured—for example, at Maxhutte, in Bavaria and Zwickau, in Saxony, the steel there having been rolled into rails containing 0.10 carbon and from 0.18 to 0.20 per cent. phosphorus. It is prudent therefore to wait until we have fuller details about the process at Terre Noire and its economical results, before attaching too much importance to an announcement almost too good to be believed by those who have had much experience in the working of iron and steel containing phosphorus.

Prizes Offered in Connection with Steel.—The French Societe d'Encouragement has announced a prize of 6000 fr. (£240) to be awarded in 1878 for "A theory of steel, based on reliable experiments, and capable of being applied directly to the improvement in its manufacture;" also another prize of 3000 fr. (£120), to be awarded in 1876 for an industrial process for the manufacture of cast steel rails from common iron ores containing, like those from carboniferous and oolitic formations, from 0.5 to 1.5 per cent. of phosphoric acid.

In Germany, also, attention is being directed to the same subject, and Dr. Dubois Reymond, one of the secretaries of the Academy of Science, of Berlin, has announced that a prize of a hundred ducats (about £40) will be awarded in July, 1876, for the best memoir in which the question is experimentally answered as to whether the

changes which take place in the tempering of steel are due to physical or chemical causes, or to a combination of both. Comparative analyses specially directed to the amounts of carbon in the steel, and its condition as free or combined carbon, are required, as well as observations relative to the physical characters of the metal. The memoirs may be written in German, French, Latin or English, and must be sent in to the Academy, accompanied by a sealed note, with motto, before the 1st of March, 1876.

Rolling Mill Machinery.—The following remarks were communicated to the foreign secretary in a letter from Mr. William Hewitt, of the Trenton Iron Company, N. J., dated from Hoboken, April 22, 1874, but which unfortunately arrived just too late to be brought before the last meeting of the Institute in London. Mr. Hewitt writes as follows: "I have been very much interested lately in the articles which have appeared in your most excellent *Journal* on the subject of reversing rolling mills, and would like to say something to you, which may be of interest to some of the other members of the Institute, about a patent taken out by my father in this country and in England in 1859, for a machine for lifting and lowering the iron at the rolls on the three-high system, which seems to me to be the only natural and decidedly the most economical system; for, no matter how perfect may be the appliances for reversing, a certain amount of energy must be expended in doing this, and that means an extra consumption of coal, or an extra amount of labor consequent upon the appliances used, beside the wear and tear of machinery; and it is astonishing to me that in all of your discussions, so little is said with regard to the actual amount of energy that is required to reverse the rolls, and that no direct experiments have been made to determine this, which I have no doubt could easily be done. In fact, I have a machine now in my mind for determining this, and more especially for determining the amount of pressure exerted by the hot metal in passing through the rolls."

"In 1859, my father, then superintendent of the Trenton Iron Works, now the New Jersey Steel and Iron Works, found that difficulty was experienced by the men at the beam rolls, in handling iron for some heavy beams about being rolled. He conceived the idea that the mere weight of the iron might be used as a means of raising and lowering the same at the rolls. However paradoxical this may seem, by a little thought, you will soon perceive that the thing is not so absurd as it seems at first. Moreover, the feasibility of it has been demonstrated by experiment, although it has never been introduced in a single rolling mill in this country or in Great Britain, simply because no trouble was ever taken to bring it into the market, and at the time it was invented heavy work was not in such demand as it is now. A model was made of this machine, and is now in the patent office in Washington, in which the grooves in the rolls are all made of the same size, and a bar of wood employed to illustrate the motions of the machine and the iron in passing through the several grooves. It was merely necessary for the operator to enter the bar in the first groove and keep the rolls constantly turning, the bar after that being alternately raised and lowered and passing through all the grooves without being touched by hand. So, you see, it would only require two men, one on each side of the rolls, to enter the pile and to insure the entering of the iron in case the machine might, in any instance, fail to do this. I have not time to go into the details of the machine, which will be found described in the *Engineer*, vol. 9, p. 108; although the illustrations therein are so indistinct that it may require some study to understand them. These may become more intelligible when the principle of the machine is known, which may be illustrated as follows: Imagine a scale with a long and a short arm, and at the end of the long arm hangs a weight which just balances the weight of the iron at a certain point on the other arm. At this point place the train of rolls and bend the arm of the lever around below them, then it is evident that when the iron is on the side of the rolls nearest the fulcrum of the lever, the weight on the long arm will lift the iron, but when it is on the other side of the rolls furthest from the fulcrum, the weight of the iron will lift the weight on the long arm, and the iron itself will descend. In the machine, as patented, the floors on either side of the rolls, which are the long and short arms of the lever, instead of moving straight up and down, move in circular arcs toward the rolls, and thus throw the iron, which rests on rollers on the floor, into the groove. At the same time, one of the floors has a side motion, by which the iron is brought opposite and delivered into the next succeeding groove. A slight steam pressure is used to overcome the friction of the machine, which is not allowed for by the weights employed, in order that the machine may be stopped when the iron is finished. Why, then, should so much brains, ingenuity and money be wasted on the harsh and unnatural system of reversing, when such a simple and gentle system as this offers itself? I should state that the patent for this machine expired last year, and was renewed in this country, but not in England, I believe. I would also refer to a patent taken out by Mr. J. Robinson, of Laurence Pountney-lane, London. This invention is essential to the success of every three-high roll train, and I believe is not so generally adopted in England as in this country."

We notice among the foreign inventions that the Rhode Island Horse Shoe Company have taken out an English patent, No. 4263, dated 20th December, 1873, for improvements for rolling iron and other metals, and an apparatus connected therewith. La Societe Marill Freres, Rive de Gier, France, No. 663, dated Feb. 21, 1874, have also patented improvements in the

construction and manufacture of armor plates.

Volumetric Determination of Iron.—To shorten the time occupied in reducing ferric chloride of iron by means of zinc, and to diminish the quantity of that metal employed, M. A. Kopp, in the *Monteur Scientifique* du Dr. Quesneville, for April, 1874, recommends the addition of a little protochloride of tin as greatly facilitating the reduction. According to him, a few drops of a solution of protochloride of tin are added to the ferric solution previously heated; its yellow color then becomes pale without altogether disappearing. A few fragments of zinc are then added, and the solution heated in a water bath until perfectly colorless—probably in, say, three-quarters of an hour. It is then passed through a filter, in the bottom of which a few pieces of zinc are placed for security. The filter is worked with water which has been boiled, and the liquid titrated with permanganate in the usual manner. Care must be taken not to add too much chloride of tin. With zinc alone, the reduction occupies twenty-four hours.

Determination of Sulphur in Iron and Steel.—Fresenius in the *Zeitsch. f. Analytische Chemie* 1874, 1. p. 37, recommends a modification of the older process of dissolving the iron and steel in hydrochloric acid and absorbing the sulphureted hydrogen evolved in an alkaline solution of oxide of lead, the principal difference being in his causing a current of dry hydrogen to pass through the apparatus in order to prevent any of the sulphide of lead precipitate from becoming oxidized and dissolving as sulphate of lead in the alkaline solution. As the process requires figures for its exact description, we must refer to the original paper, but consider the process neither as simple nor more accurate than one proposed by his assistant, Mr. Moffat Johnson, which is described in the same communication, and which consists in sending the evolved gas through a solution of bromine in hydrochloric acid, which is afterward evaporated in a water bath to drive off nearly all the free acid, water added, and the sulphuric acid in solution precipitated by chloride of barium, and determined as usual. If sufficient bromine is present, no sulphur will separate in the free state, but it follows of itself that the bromine employed must be free from sulphuric acid. Still another process for the estimation of sulphur in iron or steel has been proposed by Koppmayer Dingl, in which the iron also is treated with hydrochloric acid, and the sulphureted hydrogen evolved passed into a normal solution of iodine in potassium iodide, the excess of which is determined by a standard solution of sodium thiosulphate: 10 grammes of the sample, as finely broken up as possible, are placed in a half litre flask with a cork having three holes, through one of which, a tube reaching to the bottom is connected with a hydrogen apparatus, a stopcock funnel holding 50 c. c. hydrochloric acid, also reaching the bottom of the flask, passes through the second, and a tube bent at right angles occupies the third hole, and carries the gases through a series of bulbs filled with the standard solution of iodine, which is covered with a shade to prevent decomposition by sunlight. The air in the flask being expelled by a current of hydrogen, the hydrochloric acid is allowed by degrees to dissolve the metal, and after all action has ceased the flask is heated to drive out the sulphureted hydrogen; if not fully decomposed the funnel is filled with distilled water, which is allowed to enter the flask gradually as before, and when all is dissolved, the flask is heated, and the hydrogen gas again passed through. The contents of the bulbs are now rinsed into a beaker, and the excess of iodine determined by the sodium thiosulphate. In making the standard solutions, 15.05 grammes sodium thiosulphate are required to the litre of water, and 7.9375 grammes of iodine, in which case the difference of the number of cubic centimetres of iodine solution in the bulbs, and the number of c. c. of sodium thiosulphate required to neutralize the excess, gives the amount of sulphur directly in hundredths of a per cent. If 15 c. c. iodine solution had been taken and had required 10 c. c. Na₂S₂O₃ for neutralization, the sample in question would have contained 0.05 per cent. sulphur.

Estimation of Manganese in Iron, Steel and Ores.—A rapid colorimetric method of estimating the amount of manganese in pig iron, steel and iron ores, is given by A. Bremner as follows: 0.1 grammes of a substance similar to the sample to be assayed, but containing a known quantity of manganese, is placed in a crucible holding about 30 c. c., and 2 c. c. concentrated nitric acid are added, the contents being then evaporated to dryness and heated until all red fumes disappear. The residue, reduced to fine powder by a platinum spatula, is heated with 2 c. c. concentrated potash solution, all spitting being avoided, and, when dry, is again gently ignited. The fused mass, when cold, is treated with 25 c. c. water, well stirred, and, after settling for ten minutes, 5 c. c. of the supernatant clear green solution is carefully taken up by a pipette and placed in a graduated test tube. The above solution is taken as a standard, and the same weight of the sample to be examined is now treated in precisely the same manner and under the same conditions. Should the green color of the solution be deeper than in the standard, water is added to the former until the tests coincide, the increased volume indicating proportionately more manganese present in the sample, equality of volume and tint indicating equal amounts of manganese present in each. If, in any case, difficulty be found in comparing the tints, a drop of sulphuric acid added to each tube will produce the red permanganate, which yields a still more delicate comparison; but this should only be resorted to in extreme cases, as the solution quickly becomes turbid from the separation of the peroxide of manganese. Comparative assays showed that this method yielded very satisfactory results in practice.

Determination of Sulphur in Coal and Coke.—The following process is given by Eschka, in the *Oester. Zeitsch.* 1874, p. 111: One gramme of the substance is to be ignited for from three-quarters to one hour, with one gramme calcined magnesia and 0.5 gramme anhydrous carbonate of sodium in a platinum crucible so inclined as to allow access of air for consuming the carbon, the contents being frequently stirred up for the same purpose. The residue, when cold, is rubbed, while still in the crucible, with from 0.5 to one gramme of nitrate of ammonia, using a glass rod, after which the crucible is covered with the lid and again heated for five to ten minutes, when, upon cooling, it is dissolved in 200 c. c. hot water, which is evaporated to 150 c. c. and filtered. The filtrate is then acidified with a few drops of hydrochloric acid, and the sulphuric acid in the solution precipitated by chloride of barium, and determined as usual.

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Defects in Iron Construction.

The architectural iron business has, to a great extent, been developed since the beginning of the late war. The increase at that time in the wages of stonecutters gave iron construction the precedence over stone in point of economy, and many persons then engaged in the business. A sharp competition arose which resulted in effecting a reduction in prices, and in introducing many improvements and simplifications in foundry operations and the general manipulation of both cast and wrought iron. Another result, not so desirable, however, has arisen from this competition, viz., the introduction of bad workmanship into the business. Whether this has been due to carelessness or design, the ulterior cause has been the same. Faulty construction at length became so common that a voluminous restrictive law, a large portion of which related to iron construction, was passed by the New York legislature. The most important provision of the law was the appointment of an inspector for the purpose of testing all beams, girders and lintels before placing them in their position in the building. The necessity of this provision was afterward shown by the fact that, of 1787

lintels, beams and girders tested from the organization of the department to the end of 1872, 31 were found to be insufficient to bear the strain to be imposed upon them, and 15 actually broke during the test. Each of these defective pieces would probably have occasioned some accident had it been placed in its destined position. In *The Iron Age* of May 7th it was stated that an arch girder with a wrought iron tie rod used in a building in 180 Laurens street, New York, was found to have deflected $\frac{3}{4}$ of an inch, and would probably have broken but for the prompt use of an intermediate support. An arch girder designed for a building in Sixth avenue, having a $2\frac{1}{2}$ round tension rod, and estimated to sustain 50 tons, gave way at a pressure of 12 tons on account of an imperfect weld in the rod. The latter should have stood a tensile strain of 117 tons. During the test of another arch girder, intended to sustain 24 tons, with a tension rod computed to sustain a strain of 72 tons, the rod parted at a pressure of 2 tons, owing to an imperfect weld. In Sixth avenue a cast iron beam broke after being actually laid in position; the wall, however, was prevented from falling by a brick arch which lay directly over the beam. On the corner of Third avenue and One-hundred-and-third street, two lintels, which were supporting the front walls of two buildings, broke, and had to be replaced by stronger ones. During a period of twenty months it was found that in about twenty places, beams, lintels and girders had seriously deflected, requiring the placing of intermediate supports between the spans of the openings.

A practice common among iron builders is known as skinning the columns. If a specification calls for a column of a certain thickness of metal, it is the custom of the founder to make it of that thickness at the ends, but at a few inches from the ends to materially reduce the thickness. Thus he effects a saving of metal. Until recently there was no means of detecting this fraud except by boring holes through the metal, which was an expensive operation, impairing the strength of the iron. The inspector of iron construction in New York has recently made a pair of callipers 10 feet long, constructed so that one arm can be thrust inside of the column, and the thickness at any point determined. The arms of the callipers are extended so that the thickness of the metal may be seen without withdrawing the instrument from the column.

A few months ago a concurrence of defects in construction brought about a sudden disaster. A large ice house for the cooling of liquors fell to the ground a mass of ruins. The prime cause of the disaster was probably the settling of the foundations of some of the columns. The building was sustained by three rows of columns, each column resting on a base of blue stone. The bases beneath some of the columns in the two exterior rows settled slightly, causing a settlement, also, of the columns resting upon them. Such an action, of course, produced a strain upon the center row of columns, tending to split or tear the columns asunder. The settlement of the foundations had been suspected before, and its evil effects could have been prevented had the iron work been properly constructed. The columns, however, had been skinned, and instead of the metal being $1\frac{1}{2}$ inches thick, as called for in the specification, it was only $\frac{3}{4}$ inch thick. Many of the columns in the center row, therefore, when the strain came upon them, split for a considerable distance down from the top, the whole building caved slowly in, and by 10 o'clock in the evening was a perfect wreck. A further deviation had been made from the terms of the specification in the construction of the columns. The latter should have been cast with a broad, square flange or plate at the top, upon which was to rest another plate supporting the girders of the building, and the box supporting the column above. The plate, however, was not cast upon the column. The top of the column was, therefore, round, and the plate supporting the box was square and projected a considerable distance beyond the top of the column. The pressure of the sides of the box upon the plate caused the two sides of the latter to act as levers tending to tear the columns asunder, as actually occurred. A similar accident was prevented in the large ice house in Ninety-second street by a timely discovery when the plates above the capitals of the columns had already begun to crack. In this case the defects were different from those which were the cause of the accident just described. In the top of the plate over each column on which the girders rested was cast a recess intended to receive a wrought iron plate to which the girders were to be bolted. The thickness of the plate was to be a little greater than the depth of the recess in which it was placed. Its purpose was to keep the columns perfectly upright, the wrought iron piece being firmly bolted preventing the columns from swaying to

one side or the other. Also, if by reason of a great weight in the building the girders should be deflected, their weight would not come upon the edge of the plate over the capital so as to create a leverage, but would rest directly on the center of the column, the piece being higher than the recess and preventing the girder from touching the edge of the plate in which the recess was cast. The recesses were cast in the plates, but the wrought iron plates were not put in. The weight, therefore, came upon the exterior of the plates over the capitals, and tended to tear them asunder. The cracks, however, were discovered in time, the injury was repaired and the recesses filled with a composition metal. It should be remarked that a number of ice houses designed by the same architect are standing, and are apparently as sound as ever. The trouble in the cases alluded to was not in the plan but in the construction.

We mention these facts, not with any desire to weaken public confidence in the value of iron as a material of architectural construction, but in the hope of impressing upon the minds of those engaged in the business that the practices to which we have called attention are well calculated to inspire the public with a distrust of their work, and to bring iron buildings into disrepute. We are willing to make all due allowance for the embarrassments which honest founders suffer because of the sharp competition to which they are exposed—vastly more allowance, indeed, than they could expect from the public at large. We know that iron builders are often required to figure below the cost of good work to secure for their bids a moment's consideration, and that it is desirable a builder should make a profit upon his work whether the price he gets for it be high or low. At the same time it is necessary that respectable builders should make a vigorous stand against the measures commonly resorted to to make cheap contracts pay. Public confidence is easily shaken, and the fall of one iron building, or its condemnation as insecure, would do more mischief to the interest of this important branch of business than could be undone in years. No builder will confess to bad or rascally workmanship, and the blame is easily shifted upon the material, which suffers accordingly in the public estimation. Those who order work should be made to understand that an iron building is never cheap which costs less than the value of good materials and first-class workmanship, and the best way in which to draw the line is for respectable builders with reputations to lose to refuse contracts which can only be filled without loss by a recourse to discreditable practices, that can only result in injury to the business.

The Wisconsin Railroad Law Sustained.

It is, at least, a satisfaction to know that the "railroad war" in the West is approaching an issue which will at least enable the parties to the contest to understand each other better than they seem to do at present. The Wisconsin Supreme Court has affirmed the constitutionality of the Potter railroad law, and sustained the injunction, granted by the courts below, to compel compliance with its provisions on the part of the Chicago & Northwestern, and the Chicago, Milwaukee & St. Paul Railroads. This is bad news. It means that the State has power to impose upon its great lines of inter-state communication conditions and restrictions which will cause capital to shrink from investment in such enterprises, and indefinitely postpone the attainment of cheap transportation through the multiplication of competing lines. For the sake of many interests, all more important, as affecting the general welfare, than those which the Granges are supposed to represent and champion, we regret this decision. It gives a loose rein to the Legislature of Wisconsin, which may now be expected to pursue its advantage with relentless purpose, and it places the interests of those who have invested their capital in the building of railroads at the mercy of bodies of men not always representing the intelligence of the communities from which they come, who may chance to be elected for brief terms of legislative service. If this decision is sustained by the United States Supreme Court, the States which have seen fit to enact restrictive laws may be dropped, for the time, from the list of those in which a sustained railway progress may be expected, and the roads legislated against may derive such satisfaction as they can from the knowledge that the clamor of the Granges for cheap transportation will, while it lasts, effectually protect them against the only danger which they really fear—competition through the increase of transportation facilities.

It is certainly to be hoped that the Granges, and those who manipulate legis-

lation in their interest, will before long reach a correct understanding of the nature of the problem with which they are attempting to deal. They now propose to secure cheap transportation by the simple expedient of enacting laws arbitrarily fixing the rates which the railroads are permitted to charge for the carrying of freights. Evidently they do not see the consequences of such a policy; but it is still more evident that they are ignorant of the obvious fact that their interests will be promoted far more by doing away with the necessity for the transportation of their products than by making transportation cheap by means which will tend to drive capital away from railroad investments. It is folly to suppose that such a commodity as grain can bear the cost of long transportation to Eastern and foreign markets, and return to the producer any considerable part of the price which the distant consumer is required to pay for it. If it takes three or four bushels of grain to carry one bushel to market, the farmer must calculate his profits accordingly. What the Western farmers need is a home market, and this they will soonest secure by a course which will promote to the fullest extent the development of the natural, industrial and commercial resources of their respective States, which is in a marked degree dependent, first, upon the maintenance of the system of protection to home industry, and, second, upon the multiplication of railroads. For all they have, and are, the Western States must thank those who ventured the construction of railroads into new and undeveloped sections of country, on the faith of a future traffic which did not then exist, and which depended for its existence upon an immigration which the railroads invited. They are not yet in a position—and, indeed, never will be—to set their heel upon the railroad interest and declare themselves henceforth independent of the benefits it has conferred upon them. The future of the West is peculiarly dependent upon the largest and most rapid development of our railroad system, and whatever legislation tends to defeat this result will heavily react upon the States which venture such rash experiments in law making.

The Exhibition Season.

The increase in the number of industrial expositions held in different parts of the country is a gratifying indication of the growth of a popular interest in industrial progress. In addition to the regular State and county fairs, which are gradually assuming more and more this character, we have industrial exhibitions in Chicago, Cincinnati, St. Louis, Louisville, Nashville, Newark, New York, Boston, and several other cities. Those of the principal Western capitals are said to be unusually well patronized by exhibitors this year, and from accounts which reach us we conclude that the public are equally interested, since large crowds are in daily and nightly attendance. In Newark the exhibition is limited to local industries, and, to some extent, the interest in it is local also. The venerable American Institute, which is now conducting its annual fair in this city, is not, perhaps, a true representative of metropolitan enterprise, and its exhibitions are not as entirely satisfactory as we could wish. In Boston the Mechanics' Institute and in Philadelphia the Franklin Institute are doing good work in the same field, and the last named institution promises to make a showing which will be worth going a long distance to see. With these facilities open to them, manufacturers have every inducement to compete for honors and business, and we are glad to see that they are very generally making good use of their opportunities. The money expended in exhibiting goods from year to year is well invested, and those who have anything worth showing to the public cannot do better than to show it whenever a chance presents itself.

On recommendation of Mr. Bristow, the President has appointed Mr. Wm. Burnett, of Boston, to the office of Supervising Inspector General of Steamboats. Mr. Burnett has our sympathies. We do not question his eminent qualifications as an engineer, but we fear he will share the fate of Smith and his unhappy predecessors when the next steamboat boiler explosion shall reveal the fact that he was unable to prevent it. The system which Mr. Burnett is appointed to carry out is a very pretty one on paper, and the knowledge that it exists is calculated to allay the apprehensions of nervous old ladies making steamboat journeys, but there its practical usefulness ends. If the Treasury department would use its influence to secure the enactment of a code of simple laws making steamboat owners responsible for the safety of life and property committed to their care, and then employ its power to enforce those laws with rigid impartiality, leaving the steamboat owners, in the mean time, at liberty to adopt whatever precautions of safety they

might deem best, we should have a genuine reform. As it is now the government assumes the responsibility, and by a nominal compliance with the letter of certain Treasury regulations, the steamboat owners are safe against the consequences of any violation of its spirit.

New Publications.

THE IRON WORKS OF THE UNITED STATES. A Directory of the Furnaces, Rolling Mills, Steel Works, Forges and Bloomeries in every State. Prepared by The American Iron and Steel Association, No. 255 South Fourth street, Philadelphia, 1874.

This valuable work of reference, compiled by Mr. James M. Swank, Secretary of the American Iron and Steel Association, ably assisted by Mr. George H. Cope, will prove of great value for many purposes. It is a complete directory of those branches of the American iron trade which are mentioned on its title page. Under its present organization the Iron and Steel Association is doing good service, and this little volume is one of the results of the varied labors of its secretary during the past year. In its pages will be found mention of 681 completed blast furnaces, 343 rolling mills, 51 steel works, 37 forges and 47 bloomeries. Of the rolling mills 84 make rails. Of this number 62 make heavy sections, including 8 finished Bessemer works and 2 which are adding converters to their plant. The work is sufficiently accurate for the purpose for which it was intended, and is certainly free from grave errors and important omissions. It gives evidence of careful and conscientious preparation on every page, and when meager information is given, the reason for it is found in the unwillingness of the proprietors of iron works to give the desired information. The contents of the volume are well arranged and well indexed, and such information as it gives is easily accessible.

MANUAL OF PATENT LAW, with an Appendix upon the Sale of Patents, by Wm. Edgar Shoups, Counselor in Patent Causes. Hartford, 1874.

The little volume is of great interest to manufacturers and inventors, being a condensed popular treatise on the principles of patent law, based upon United States statutes as interpreted by the courts. The language is free from legal technicalities, and a careful reading of its well filled pages will give those for whom the subject has interest a very clear and correct idea of the rights, duties and obligations of inventors and patentees. From the abstract of this volume, which appears in this and previous issues of this journal, our readers may gain a very correct idea of its scope and purpose. The book is full of useful information, and we commend it to the manufacturing public.

Railway Service Reform.—The following excellent rule is hereafter to be enforced on the Lake Shore and Michigan Southern Railway: "Notice is hereby given to employees connected with the running of trains that they must make themselves perfectly familiar with the general rules printed upon the time tables, and with the special rules upon the time table of the division where they are employed. Hereafter no promotion to the position of conductor or of engineer will be made until after the candidate shall have been examined as to his knowledge and understanding of these rules by an examining board, whose certificate of qualification he must receive. The board of examination for conductors will consist of the superintendent of the division upon which the candidate is to be employed, assisted by at least one, and, if practicable, two, other superintendents of divisions. When a candidate for the position of engineer is to be examined, the board will consist of the superintendent of division, the master mechanic of the division, and, when possible, of another superintendent or master mechanic, who shall be requested by the division superintendent to sit with them. The candidate's certificate must receive the signature of all the members of the board, else his appointment will not be confirmed. The certificate must be approved, in the case of an engineer, by the general master mechanic, and in that of a conductor by the general superintendent. Proper forms for such certificates will be prepared and supplied to the superintendents of divisions. Those conductors and engineers who are now in the service will be required to pass an examination before a board similar to that designated for candidates as the convenience of the superintendent of the division will permit; and such as may prove deficient in a knowledge and comprehension of the general and special rules will be suspended from the service until they shall be found qualified to receive a certificate."

The Lake Superior Iron Product.—The following table will show the total shipments in gross tons from the Lake Superior iron district for the season of 1874, up to September 3:

IRON ORE.	
From Marquette.....	303,045
From Escanaba.....	185,648
From L'Anse.....	58,400
Total.....	546,893
FIG IRON.	
From Marquette.....	13,164
From Escanaba.....	9,433
From Grand Island.....	4,833
Total.....	27,430

The Swedish Mining Company at their last general meeting voted considerable sums as subsidies toward the further development of the mineral interests of the country, among which may be mentioned an augmentation of their annual contribution to the school of mining at Falun and Philipstad—25,000 kronen for a testing machine for iron and steel, to be erected at Stockholm, 100,000 kronen for the purchase of a boring apparatus, and 25,000 kronen in aid of the fund for securing a worthy representation of the industry and produce of Sweden at the great Centenary exhibition in 1876 at Philadelphia.

Metallurgical Technology.

We condense the following from the able report of Mr. David Forbes, published in the proceedings of the British Iron and Steel Institute, vol. 1, 1874, just received:

Texture of Iron.—In the *Annales des Mines*, No. 1 for 1874, pp. 90-108, there is a paper, entitled "Recherches sur la Texture du Fer," by M. Janoyer, director of iron forges, the object of which is to prove that the so long employed classification of irons into those which have a granular, fibrous, or mixed fibro granular texture, is founded on erroneous suppositions, and that the only texture really inherent or characteristic of iron is the granular, the other varieties being entirely due to imperfect welding in the manufacture of the iron. This conclusion he arrives at from a study of the results obtained in the different modes of manufacture, and the microscopic structure of the irons so produced. Considering the intimate relations which exist between the physical properties of the iron and the state of the welding of its mass, he remarks, on the subject of density—that, as might a priori be expected, granular iron being more perfectly welded, is naturally more compact and homogeneous than fibrous iron, and may be considered to vary in density from 7.780 to 7.791, whereas, the specific gravity of fibrous iron is not higher than from 7.60 to 7.751. As regards hardness, he agrees with the old assertion of Karsten, that the better the iron the harder it is, and that the best iron shows a pure silvery granular fracture, which is the type of a thoroughly welded iron, one in which no interposed foreign matter can be perceived, nor any solution of continuity detected. With respect to tenacity, this must be looked at from three aspects, i. e., resistance to traction, to compression, or to flexion. Granular iron being welded throughout its entire mass must necessarily be that which offers most resistance to traction and compression, as, in equal sections, the surfaces to be separated are greater than in the case of fibrous iron. On the other hand, however, fibrous iron, as it allows the particles of the bar to approach still closer to one another before the moment of fracture, is more flexible, although less elastic, than granular iron. As to malleability or the property of extension under the hammer, this is more developed in soft, i. e., fibrous or non-welded iron than in the harder granular iron; and, lastly, as to ductility or the property of being drawn into wire more or less fine without breaking, this depends on two conditions, viz., that the iron is at the same time sufficiently homogeneous in order to pass through the hole in the drawing plate, and tenacious to support the traction. For these purposes hard iron, or that in which the grains are perfectly welded to one another, is the only proper material, as fibrous iron, from its not being perfectly welded, is not sufficiently homogeneous, and consequently is liable to break off at any moment.

According to M. Janoyer, the influence exerted by sulphur and phosphorus on the texture of iron is totally different, the former having the tendency to produce fibrous or badly welded, whilst the latter does not interfere with the welding, and results generally in granular iron.

At the end of this paper are appended some observations by Professor Gruner, in which that gentleman, although agreeing in the main with the result of M. Janoyer's researches, remarks that he appears to confuse fracture with texture. The fracture of a bar of iron does not necessarily represent its normal texture, and can present a very different appearance in the same bar of iron according as it is effected by a sudden violent shock or by a slow and gradual flexure.

Dephosphorizing Iron Ores.—In several of the foreign reports, allusions have been made to Jacobi's process for dephosphorizing the iron ores previous to their being smelted in the blast furnace by treatment with a solution of sulphurous acid, and as the author of this report had, in June, an opportunity, through the kindness of Director Jacobi, of inspecting this process in operation on a large scale at the Adalbert Iron Works, at Kladrno, in Bohemia, it is here proposed to give a sketch of the process as there carried on: The iron ores thus treated are found in the Lower Silurian formation, as a bed some fifty feet in thickness, and are of a dark blackish gray color, with frequently traces of a pisolitic structure, and often containing particles attributable by the magnet. They are in appearance altogether identical with the iron ores which are found inter-stratified with the Llandovery beds on the west side of Cader Idris, in Wales, near Dolgelly, and seem also to be of much the same chemical composition. The ores at Kladrno are first roasted in small round kilns, after which they are placed in tanks; those at the Adalbert Works contained, in all, about four thousand tons of ore, in which they are submitted for some time to the action of water containing sulphurous acid (which is made by burning ordinary iron pyrites and condensing the acid fumes with water in two towers). The result of this is that a solution is obtained which contains the major part of the phosphoric acid present in the ore (from 3 to 3.3 per cent.) in the form of phosphate of alumina, which, when drawn off, leaves the ore in a comparative state of purity, i. e., almost free from sulphur, which is also removed by the calcination and subsequent working, and with only from 0.28 to 0.4 per cent. phosphoric acid, so as to be suitable for making excellent rails, girders, and bar iron, for which, before this treatment, it was altogether unfitted. Taking advantage of the property which such a solution of phosphate of alumina in sulphurous acid has, of again depositing the dissolved phosphate of alumina, upon merely boiling and so expelling the sulphurous acid; the solution, when drawn off from the iron ore, is passed through a coil of iron pipes heated in a furnace, and allowed

whilst boiling, to run into settling tanks, in which the phosphate of alumina deposits itself, and from which (after draining off the supernatant water) it is removed and dried, in which state it is sold as manure, for which purpose it is eagerly purchased, as it has proved to be an excellent fertilizing agent. According to Herr Jacobi, in the air-dried state in which it is sold, as a soft, chalky-white powder, it contains from 30 to 33 per cent. phosphoric acid, 26 to 33 per cent. alumina, 8 to 10 per cent. sulphuric acid, 2 to 3½ per cent. silica, 20 to 25 per cent. water, and, strange enough, only from 1 to 2 per cent. oxide of iron, the iron in the ore being all but unattacked by the solution of sulphurous acid. During the boiling operation, the sulphurous acid, which is given off in the pipes, is reconducted to the condensing towers, and thus is made use of again and again. As, according to Herr Jacobi, the sale of the phosphate of alumina covers the entire expenses of the process, it seems highly probable that it might pay to use this process for purifying Welsh ores, since they contain from 38 to 51 per cent. metallic iron, and can be mined at a very cheap rate.

Calcination of Native Oxides of Iron.—In Sweden, and most other countries where iron is smelted with charcoal, the universal practice, from the most ancient times, has been to subject the nearly pure native magnetic and specular oxides of iron to a preliminary calcination before charging them into the blast furnace—the reasons for so doing, if we except the statement that in practice it has been found better, have been variously given, and metallurgists generally are not agreed as to the true explanation as to why this preliminary calcination should be necessary. The results of an experimental inquiry into this subject have recently been published by M. H. Tholander in the 1st and 2d numbers of *Jernkontorets Annaler* for this year, which, however, have reached us too late to prepare an abstract for this present report.

Smelting Iron Ores with Lignite.—This is a very important question in countries in which the coal is of recentage and not suitable for coke making, as most of the carboniferous formation coal is. It has attracted special attention in Austria, and the first part of a communication on the subject, by Dr. von Reichenbach, of Vienna, which gives a history of the different experiments that have been already tried in this direction, will be found in the *Berg u. Huettenmaennische Zeitung*, for June 12, 1874. Until, however, the whole of this paper has been published, we abstain from attempting an abstract.

Introducing Gases into Blast Furnaces.—A patent has been taken out in this country, No. 3843, dated November 23, 1873, which is a communication from E. Andre, of Weitzlar, in Nassau, for an arrangement by which carbonic oxide or other combustible gas can be introduced into furnaces, or rather sucked in by the force of the blast through a tube placed like an injector within the water tuyeres. There is little doubt of this arrangement succeeding, but it is another question as to whether there can be a corresponding advantage gained by using the gases in this manner.

Casting from Blast Furnaces or Cupola.—The question as to whether castings, made direct from the blast furnace, are as strong and good in quality as when the same iron is remelted in the cupola, as in many Continental countries it is made a special condition "the castings to be from the cupola," has been often investigated, and is the subject of a paper by A. Ledebur, in the *Berg und Huettenmaennische Zeitung*, for January 9th, 1874. The experiments cited in this communication appear to prove that the same iron, after remelting in a cupola, is not so strong as it was originally when cast direct from the blast furnace, and leads to the conclusion that the insisting upon the iron being cast from the cupola is no guarantee for its being of better quality—and often may be the reverse—but that a great deal depends upon the class of ores and fuel used in the blast furnace, and the mode in which the smelting is conducted. In the charcoal furnaces in Sweden and Norway, when extra strong castings are required, they are always cast direct from the blast furnace, although this is not done where fineness of casting or ornament is to be attended to.

Puddling Iron.—An interesting paper, entitled "Observations pratiques sur le Puddlage," by J. Wolters, of the forges of the Societe Anonyme de la Providence, is published in the first No. of the *Annuaire de l'Association des Ingenieurs sortis de l'Ecole de Liege*, p. 34, which, as it is also reproduced in the *Revue Universelle des Mines*, will most probably appear in the English edition of that journal.

From Belgium, we learn that M. Masion, one of the managers of the rolling mills of La Renaissance, at Louvroil, has taken out a patent for a furnace for puddling and reheating upon a new system, by which, according to the inventor, a saving of from 30 to 40 per cent. fuel is to be effected; as yet, however, we have not received any particulars of this invention.

Alloys of Iron.—A patent, No. 3247, dated October 7, 1873, for the "Treatment and compounding of cast iron with other metals or materials," being a communication from W. M. Arnold, of New York, U. S., claims the alloying of cast iron in its molten state with copper, tin, zinc, manganese, and antimony, the compound metals being melted in a crucible, and added to the cast iron in a molten state. The best proportions for common gray iron are stated to be: copper, 1 lb.; tin, ½ lb.; zinc, 3 lbs.; manganese, ½ lb.; antimony for hardening without chilling, ¼ to ½ lb. to each hundred pounds of iron. The result is stated to be that of "removing the oxides, sulphur, and phosphorus, and reducing the carbon, electrifying and galvanizing the iron in a molten state"—what the latter expressions mean it is difficult to say.

Another patent, No. 3398, dated October 9,

1873, is a claim by M. S. L. Delalot, of Paris, for alloying iron and steel with nickel or cobalt, or a mixture of both metals in certain proportions, by which it is asserted that the product is rendered proof against rusting on exposure to the atmosphere, water, or other oxidizing influences, and it is further stated that cast iron so alloyed can be converted into wrought iron or steel by the usual methods.

Bessemer Steel.—To prevent the formation of cracks in larger castings, especially in Bessemer steel ingots, Herr von Ebreneworth recommends casting the ingots at the lowest possible temperature, for which purpose he advises the opening through which the metal is poured into the mold to be very small, so that the operation may be protracted as long as possible—where the metal in the converter is very hot and liquid this may be advisable, but, in Sweden, where this is not the case, it is found necessary to lose no time in filling the ingots in order to prevent the solidification of the steel itself in the pouring ladles.

Sulphureted Steel.—Great excitement was manifested generally on the Continent by the announcement published in the *Bulletin du Comité des forges de France*, that the great problem of the manufacture of steel from cast irons containing phosphorus, had been at last solved at the Terre Noire Works, and at the meeting of the Societe des Ingenieurs Civils, of the 30th February, the president, Professor Jordan, called upon M. Euverte, the manager of the Terre Noire Works, to communicate the results which had been obtained in this direction. After some introductory remarks tracing the improvement generally introduced into the practice of the Bessemer process, he directed attention to the superior results obtained by the substitution of ferro-manganese for spegeleisen (some of which were published in the *Journal* of the Institute by the late Mr. Kohn), and then to experiments made by M. de Wendel, on a large scale, at Hayange, to test the possibility of making steel from the ores of the extensive mineral deposits of the Moselle, notwithstanding their containing a high percentage of phosphorus. The experimental pig iron, first puddled with great care, was melted down in a Siemens-Martin furnace, and the ingots then sent to Terre Noire to be rolled into steel rails, and, although not entirely successful, these results were so encouraging as to show that the object was not impossible of attainment, and led to other more decisive trials being made. For some years past M. Tiesse du Motay had also been making experiments on the same subject at Commines, which experiments were also transferred to Terre Noire for further prosecution. The results of the united experiments showed that, although it was not possible to eliminate the phosphorus in any rapid process like that of Bessemer, it was possible, under certain determined circumstances, to allow the phosphorus to remain in the steel without having any injurious effect upon its qualities—and it was proved that even with tolerably large amounts of phosphorus introduced into the steel in a Siemens-Martin furnace, the operation when completed by the addition of ferro-manganese (containing 42 per cent. of metallic manganese) yielded a malleable steel of good merchantable quality, and a repetition of such experiments elicited the conclusion that—"phosphorus may be introduced into cast steel provided the carbon be eliminated; and the less carbon there remains, the more phosphorus may be left."

The practical experience already acquired at the Terre Noire Works proves, according to M. Euverte, that a steel containing about three thousandths parts of phosphorus with one-and-a-half thousandths part of carbon is very malleable and fit for making rails of good quality, but as yet the precise quantities of phosphorus and carbon which can be present at the same time in steel of good quality has not been definitely determined.

M. Euverte alluded to the great future of this discovery, especially pointing out that there were at least some thirty millions of bad iron rails now in the world, which could be converted into cast steel rails. The mode of manufacturing the ferro-manganese employed at Terre Noire has already been given in our last foreign report, and it is stated that its cost price is about 1/6 per lb., while the addition of only 2 per cent. of it to the bath of steel is quite sufficient to effect the desired transformation.

As a discovery, the principle enunciated here is not new (it was held by the late Mr. Matthiessen), and steels containing phosphorus have years ago been manufactured—for example, at Maxhuetten, in Bavaria and Zwickau, in Saxony, the steel there having been rolled into rails containing 0.10 carbon and from 0.18 to 0.20 per cent. phosphorus. It is prudent therefore to wait until we have fuller details about the process at Terre Noire and its economical results, before attaching too much importance to an announcement almost too good to be believed by those who have had much experience in the working of iron and steel containing phosphorus.

Prizes Offered in Connection with Steel.—The French Societe d'Encouragement has announced a prize of 6000 fr. (£240) to be awarded in 1878 for "A theory of steel, based on reliable experiments, and capable of being applied directly to the improvement in its manufacture;" also another prize of 3000 fr. (£120) to be awarded in 1876 for an industrial process for the manufacture of cast steel rails from common iron ores containing, like those from carboniferous and oolitic formations, from 0.5 to 1.5 per cent. of phosphoric acid.

In Germany, also, attention is being directed to the same subject, and Dr. Dubois Reymond, one of the secretaries of the Academy of Science, of Berlin, has announced that a prize of a hundred ducats (about £40) will be awarded in July, 1876, for the best memoir in which the question is experimentally answered as to whether the

changes which take place in the tempering of steel are due to physical or chemical causes, or to a combination of both. Comparative analyses specially directed to the amounts of carbon in the steel, and its condition as free or combined carbon, are required, as well as observations relative to the physical characters of the metal. The memoirs may be written in German, French, Latin or English, and must be sent in to the Academy, accompanied by a sealed note, with motto, before the 1st of March, 1876.

Rolling Mill Machinery.—The following remarks were communicated to the foreign secretary in a letter from Mr. William Hewitt, of the Trenton Iron Company, N. J., dated from Hoboken, April 22, 1874, but which unfortunately arrived just too late to be brought before the last meeting of the Institute in London. Mr. Hewitt writes as follows: "I have been very much interested lately in the articles which have appeared in your most excellent *Journal* on the subject of reversing rolling mills, and would like to say something to you, which may be of interest to some of the other members of the Institute, about a patent taken out by my father in this country and in England in 1859, for a machine for lifting and lowering the iron at the rolls on the three-high system, which seems to me to be the only natural and decidedly the most economical system; for, no matter how perfect may be the appliances for reversing, a certain amount of energy must be expended in doing this, and that means an extra consumption of coal, or an extra amount of labor consequent upon the appliances used, beside the wear and tear of machinery; and it is astonishing to me that in all of your discussions, so little is said with regard to the actual amount of energy that is required to reverse the rolls, and that no direct experiments have been made to determine this, which I have no doubt could easily be done. In fact, I have a machine now in my mind for determining this, and more especially for determining the amount of pressure exerted by the hot metal in passing through the rolls."

"In 1859, my father, then superintendent of the Trenton Iron Works, now the New Jersey Steel and Iron Works, found that difficulty was experienced by the men at the beam rolls, in handling iron for some heavy beams about being rolled. He conceived the idea that the mere weight of the iron might be used as a means of raising and lowering the same at the rolls. However paradoxical this may seem, by a little thought, you will soon perceive that the thing is not so absurd as it seems at first. Moreover, the feasibility of it has been demonstrated by experiment, although it has never been introduced in a single rolling mill in this country or in Great Britain, simply because no trouble was ever taken to bring it into the market, and at the time it was invented heavy work was not in such demand as it is now. A model was made of this machine, and is now in the patent office in Washington, in which the grooves in the rolls are all made of the same size, and a bar of wood employed to illustrate the motions of the machine and the iron in passing through the several grooves. It was merely necessary for the operator to enter the bar in the first groove and keep the rolls constantly turning, the bar after that being alternately raised and lowered and passing through all the grooves without being touched by hand. So, you see, it would only require two men, one on each side of the rolls, to enter the pile and to insure the entering of the iron in case the machine might, in any instance, fail to do this. I have not time to go into the details of the machine, which will be found described in the *Engineer*, vol. 9, p. 108; although the illustrations therein are so indistinct that it may require some study to understand them. These may become more intelligible when the principle of the machine is known, which may be illustrated as follows: Imagine a scale with a long and a short arm, and at the end of the long arm hangs a weight which just balances the weight of the iron at a certain point on the other arm. At this point place the train of rolls and bend the arm of the lever around below them, then it is evident that when the iron is on the side of the rolls nearest the fulcrum of the lever, the weight on the long arm will lift the iron, but when it is on the other side of the rolls furthest from the fulcrum, the weight of the iron will lift the weight on the long arm, and the iron itself will descend. In the machine, as patented, the floors on either side of the rolls, which are the long and short arms of the lever, instead of moving straight up and down, move in circular arcs toward the rolls, and thus throw the iron, which rests on rollers on the floor, into the groove. At the same time, one of the floors has a side motion, by which the iron is brought opposite and delivered into the next succeeding groove. A slight steam pressure is used to overcome the friction of the machine, which is not allowed for by the weights employed, in order that the machine may be stopped when the iron is finished. Why, then, should so much brains, ingenuity and money be wasted on the harsh and unnatural system of reversing, when such a simple and gentle system as this offers itself? I should state that the patent for this machine expired last year, and was renewed in this country, but not in England, I believe. I would also refer to a patent taken out by Mr. J. Robinson, of Laurence Pountney-lane, London. This invention is essential to the success of every three-high roll train, and I believe is not so generally adopted in England as in this country."

We notice among the foreign inventions that the Rhode Island Horse Shoe Company have taken out an English patent, No. 4263, dated 20th December, 1873, for improvements for rolling iron and other metals, and an apparatus connected therewith. La Societe Marill Freres, Rive de Gier, France, No. 663, dated Feb. 21, 1874, have also patented improvements in the

construction and manufacture of armor plates.

Volumetric Determination of Iron.—To shorten the time occupied in reducing ferric chloride of iron by means of zinc, and to diminish the quantity of that metal employed, M. A. Kopp, in the *Moniteur Scientifique* du Dr. Queneville, for April, 1874, recommends the addition of a little protochloride of tin as greatly facilitating the reduction. According to him, a few drops of a solution of protochloride of tin are added to the ferric solution previously heated; its yellow color then becomes pale without altogether disappearing. A few fragments of zinc are then added, and the solution heated in a water bath until perfectly colorless—probably in, say, three-quarters of an hour. It is then passed through a filter, in the bottom of which a few pieces of zinc are placed for security. The filter is worked with water which has been boiled, and the liquid titrated with permanganate in the usual manner. Care must be taken not to add too much chloride of tin. With zinc alone, the reduction occupies twenty-four hours.

Determination of Sulphur in Iron and Steel.—Fresenius in the *Zeitsch. f. Analytische Chemie* 1874, 1. p. 37, recommends a modification of the older process of dissolving the iron and steel in hydrochloric acid and absorbing the sulphureted hydrogen evolved in an alkaline solution of oxide of lead, the principal difference being in his causing a current of dry hydrogen to pass through the apparatus in order to prevent any of the sulphide of lead precipitate from becoming oxidized and dissolving as sulphate of lead in the alkaline solution. As the process requires figures for its exact description, we must refer to the original paper, but consider the process neither as simple nor more accurate than one proposed by his assistant, Mr. Moffat Johnson, which is described in the same communication, and which consists in sending the evolved gas through a solution of bromine in hydrochloric acid, which is afterward evaporated in a water bath to drive off nearly all the free acid, water added, and the sulphuric acid in solution precipitated by chloride of barium, and determined as usual. If sufficient bromine is present, no sulphur will separate in the free state, but it follows of itself that the bromine employed must be free from sulphuric acid. Still another process for the estimation of sulphur in iron or steel has been proposed by Koppmayer Dingl, in which the iron also is treated with hydrochloric acid, and the sulphureted hydrogen evolved passed into a normal solution of iodine in potassium iodide, the excess of which is determined by a standard solution of sodium thiosulphate: 10 grammes of the sample, as finely broken up as possible, are placed in a half litre flask with a cork having three holes, through one of which, a tube reaching to the bottom is connected with a hydrogen apparatus, a stopcock funnel holding 50 c. c. hydrochloric acid, also reaching the bottom of the flask, passes through the second, and a tube bent at right angles occupies the third hole, and carries the gases through a series of bulbs filled with the standard solution of iodine, which is covered with a shade to prevent decomposition by sunlight. The air in the flask being expelled by a current of hydrogen, the hydrochloric acid is allowed by degrees to dissolve the metal, and after all action has ceased the flask is heated to drive out the sulphureted hydrogen; if not fully decomposed the funnel is filled with distilled water, which is allowed to enter the flask gradually as before, and when all is dissolved, the flask is heated, and the hydrogen gas again passed through. The contents of the bulbs are now rinsed into a beaker, and the excess of iodine determined by the sodium thiosulphate. In making the standard solutions, 15.05 grammes sodium thiosulphate are required to the litre of water, and 7.9575 grammes of iodine, in which case the difference of the number of cubic centimetres of iodine solution in the bulbs, and the number of c. c. of sodium thiosulphate required to neutralize the excess, gives the amount of sulphur directly in hundredths of a per cent. If 15 c. c. iodine solution had been taken and had required 10 c. c. Na₂S₂O₃ for neutralization, the sample in question would have contained 0.05 per cent. sulphur.

Estimation of Manganese in Iron, Steel and Ores.—A rapid colorimetric method of estimating the amount of manganese in pig iron, steel and iron ores, is given by A. Bremner as follows: 0.1 gramme of a substance similar to the sample to be assayed, but containing a known quantity of manganese, is placed in a crucible holding about 30 c. c., and 2 c. c. concentrated nitric acid are added, the contents being then evaporated to dryness and heated until all red fumes disappear. The residue, reduced to fine powder by a platinum spatula, is heated with 2 c. c. concentrated potash solution, all spitting being avoided, and, when dry, is again gently ignited. The fused mass, when cold, is treated with 25 c. c. water, well stirred, and, after settling for ten minutes, 5 c. c. of the supernatant clear green solution is carefully taken up by a pipette and placed in a graduated test tube. The above solution is taken as a standard, and the same weight of the sample to be examined is now treated in precisely the same manner and under the same conditions. Should the green color of the solution be deeper than in the standard, water is added to the former until the tests coincide, the increased volume indicating proportionally more manganese present in the sample, equality of volume and tint indicating equal amounts of manganese present in each. If, in any case, difficulty be found in comparing the tints, a drop of sulphuric acid added to each tube will produce the red permanganate, which yields a still more delicate comparison; but this should only be resorted to in extreme cases, as the solution quickly becomes turbid from the separation of the peroxide of manganese. Comparative assays showed that this method yielded very satisfactory results in practice.

Determination of Sulphur in Coal and Coke.—The following process is given by Eschka, in the *Oesterr. Zeitschr.* 1874, p. 111: One gramme of the substance is to be ignited for from three-quarters to one hour, with one gramme calcined magnesia and 0.5 gramme anhydrous carbonate of sodium in a platinum crucible so inclined as to allow access of air for consuming the carbon, the contents being frequently stirred up for the same purpose. The residue, when cold, is rubbed, while still in the crucible, with from 0.5 to one gramme of nitrate of ammonia, using a glass rod, after which the crucible is covered with the lid and again heated for five to ten minutes, when, upon cooling, it is dissolved in 200 c. c. hot water, which is evaporated to 150 c. c. and filtered. The filtrate is then acidified with a few drops of hydrochloric acid, and the sulphuric acid in the solution precipitated by chloride of barium, and determined as usual.

Trade Report.

Office of THE IRON AGE.
WEDNESDAY EVENING, Sept. 16, 1874.

The general improvement noted in our last review of the financial markets has continued during the past week, not only in Wall street but in the general markets. Everywhere we hear the confident belief expressed that the fall trade, though late, will be good, and a better feeling prevails than was noticeable last week. Returning prosperity will find business done upon a sounder and safer basis than heretofore, and whether the promise of the fall and winter trade is realized or not, there is but little doubt that next year will witness the beginning of a new era of general and sustained prosperity, of rapid industrial development, and an equally rapid increase in national wealth. During the past week the money market has continued easy to borrowers on call, who have been freely accommodated at 2 @ 3 per cent. Prime mercantile paper is quotable at 5 1/2 @ 7 1/2 per cent.

In the gold market the decline in foreign exchange brought the premium down to 109 1/2. On Thursday \$1,000,000 was sold on account of the Treasury at 109 1/2 @ 109 3/4. The following shows the daily range of the premium:

	Highest.	Lowest.
Thursday	109 1/2	109 1/2
Friday	109 1/2	109 1/2
Saturday	109 1/2	109 1/2
Sunday	109 1/2	109 1/2
Monday	109 1/2	109 1/2
Tuesday	109 1/2	109 1/2
Wednesday	110	109 1/2

The stock market has been more active than at any time since the beginning of warm weather, with a decided upward tendency in prices. The principal dealings have been in Western Union, Lake Shore, Union Pacific, Wabash, Pacific Mail, New York Central and Rock Island. The highest and lowest of today's quotations of active shares are given below.

The bond market has been quiet, with a limited business in investment securities. The last bank statement shows that the banks hold \$971,800 more specie than during the preceding week, and \$278,000 less legal tenders. There has been a gain in deposits of \$3,136,500, and an increase in loans of \$1,782,900. The total reserve is \$693,000 larger than during the preceding week, the banks now holding \$35,189,000, the law only requiring \$59,470,625. The excess of lawful money above legal reserve is \$91,125 less than last week. The following is a comparison of the averages of the past two weeks:

	Sept. 5.	Sept. 12.	Difference.
Loans	\$374,084,900	\$381,867,800	Inc. \$7,782,900
Specie	18,891,300	19,863,100	Inc. 971,800
Leg. Ten.	65,604,700	63,393,900	Dec. 2,210,800
Deposits	\$24,746,000	\$27,882,500	Inc. 3,136,500
Circulation	\$5,662,400	\$5,605,700	Dec. 56,700

The Treasurer of the United States has issued a circular requesting national banks to make an additional deposit of five per cent. for the redemption of their circulation, with instructions that the United States notes may be sent to the Treasurer under the contract of the Treasury Department with Adams Express Company, and under the same regulations as are prescribed for the forwarding of notes and currency of the United States for redemption. This is an absurd request, and probably no attention will be paid to it by the banks. The difficulty would be promptly and satisfactorily met by the publication, by the Treasurer, of a notice that no further payment on account of redemption could be made until the department had brought up its arrears and replenished its deposit fund. Mr. Spinner has no shadow of warrant for such a demand upon the banks, and if they comply with it, it will be at their own risk, as the government is in no respect responsible for the safe keeping or return of any part of the \$17,000,000 called for.

The following tables show the movements in foreign trade for the week:

	1872.	1873.	1874.
Total for week	\$3,056,294	\$6,676,605	\$6,953,577
Prev. reported	\$30,034,329	\$83,858,757	\$81,814,066
Since Jan. 1	\$317,120,553	\$300,535,362	\$338,767,563

Included in the imports of general merchandise for the week are:

	Quant.	Value.
Brass goods	17	\$3,097
Bronzes	61	13,281
Chains and anchors	25	136
Copper	78	483
Cutlery	78	26,694
Guns	60	14,432
Hardware	99	9,444
Railroad bars	73	37,378
Iron, other tons	736	41,280
Lead pigs	3,907	23,164
Metal goods	234	10,314
Nails	9	966
Old metal	16	1,406
Per. caps	3	499
Saddlery	7	1,319
Steel	39	39,818
Spelter	10,800	5,266
Tin, boxes	9,544	89,288
Tin, 5007 slabs	443,021	89,538
Wire	21	5,663

	1872.	1873.	1874.
For the week	\$4,909,969	\$6,386,288	\$4,591,531
Prev. reported	\$151,593,515	\$195,785,281	\$213,767,490
Since Jan. 1	\$150,503,354	\$208,171,969	\$208,359,021

EXPORTS OF SPECIE.

	1872.	1873.	1874.
For the week	\$4,909,969	\$6,386,288	\$4,591,531
Prev. reported	\$151,593,515	\$195,785,281	\$213,767,490
Since Jan. 1	\$150,503,354	\$208,171,969	\$208,359,021

	Bid.	Asked.
U. S. Currency 6's	117 1/2	117 1/2
U. S. 6's 1881, reg.	117 1/2	117 1/2
U. S. 6's 1881, con.	118	118 1/2
U. S. 6's 20 reg.	117 1/2	117 1/2
U. S. 5-20 1882, con.	112 1/2	112 1/2
U. S. 5-20 1884, reg.	112 1/2	112 1/2
U. S. 5-20 1884, con.	112 1/2	112 1/2
U. S. 5-20 1885, reg.	112 1/2	112 1/2
U. S. 5-20 1885, con.	112 1/2	112 1/2
U. S. 5-20 1886, reg.	112 1/2	112 1/2
U. S. 5-20 1886, con.	112 1/2	112 1/2
U. S. 5-20 1887, reg.	112 1/2	112 1/2
U. S. 5-20 1887, con.	112 1/2	112 1/2
U. S. 5-20 1888, reg.	112 1/2	112 1/2
U. S. 5-20 1888, con.	112 1/2	112 1/2
U. S. 10-40 con.	110 1/2	110 1/2
U. S. 10-40 con.	111 1/2	111 1/2
U. S. 10-40 con.	111 1/2	111 1/2
U. S. 10-40 con.	111 1/2	111 1/2

The following were the highest and lowest prices of stocks to-day:

	Highest.	Lowest.
N. Y. Cen. & Hudson Consolidated	101 1/4	101 1/4
Lake Shore	75 1/2	75 1/2
Rock Island	101	100 1/2
Wabash	125	125
Harlem	125	125
Western Union Telegraph	79 1/2	79 1/2
Northwestern	35 1/2	35 1/2
Preferred	35 1/2	35 1/2
Milwaukee & St. Paul	52 1/2	52 1/2
Pref.	52 1/2	52 1/2
Panama	113	113
Pacific Mail	47 1/2	47 1/2
Erie	34 1/2	34 1/2
Ohio & Mississippi	24 1/2	24 1/2
Union Pacific	31 1/2	31 1/2
C. & Ind. Central	8 1/2	8 1/2
At. & Pa. prf.	18 1/2	18 1/2
Quicksilver prf.	39	39

GENERAL HARDWARE.

There is a general complaint that business is not up to the usual standard for the season. For the past few days orders have come in very sparingly. As a rule, orders have been light from the beginning, but this seems to have been more the case for the past few days than before. There seems to be no question that stocks are nowhere heavy, but there are sections where money is very scarce. It is this week just a year since the panic broke out, and we do not seem to have made much progress in overcoming its effects, but we have unquestionably been settling down to a more normal range of values, many things being about as low as before the war.

Regarding Western business, we extract the following from a letter from Sample, Birge & Co., St. Louis, under date of the 14th inst.:

Trade from the cotton regions begins to move freely. A settling of old scores has already commenced, and many to whom advances had been made, as far as practicable until the result of the present crop was settled, are once more entitled to credit. Prices of Sheet Iron have advanced a trifle, and metals are firm, with an upward tendency. Business in Hardware and iron is good, and although demand from the grasshopper region of Kansas and Nebraska is light, yet, on the whole, the trade tributary to St. Louis is good, and indications are cheerful for an active fall trade.

In Foreign Hardware there seems to be nothing worthy of special remark. The trade here is characterized by the same general features as Domestic Hardware, while there is no change on the other side to report, either in the matter of prices or in the state of affairs. The downward tendency of prices has been checked there, and we have heard the opinion expressed by well-informed persons that the bottom has been reached.

The United States Iron and Tin Plate Company inform us that their works are now in full operation, and that they are prepared to receive orders for all kinds and sizes of Roofing and Bright Tin, as well as for various kinds of Charcoal and Common Black Plate. They say: "We assure you that we have not omitted any exertions to bring experience and skilled labor into our works; and we now feel confident that we are fully able to compete with European manufacturers, as well in price as in quality." The manufacture of Tin Plate is a new industry in this country, and we would be glad to see this company succeed. Their works are at McKeesport, Pa., but they may also be addressed P. O. Box 1075, Pittsburgh. The officers are J. D. Strous, president; W. O. Davis, superintendent; H. H. Demmler, treasurer; W. C. Cronmeyer, secretary.

Clark & Co., of Buffalo, issue, under date of Sept. 10, the following circular:

"UNITED STATES DISTRICT COURT.—Adjudged Term now being held in Buffalo, Hon. Wm. J. Wallace presiding.

In the suit of C. B. Clark and E. L. Ferguson vs. O. S. Garretson for infringement of Letters Patent of 'Clark's No. 1 Gravity Locking Blind Hinges,' manufactured by Clark & Co., of Buffalo, N. Y.

"On a motion for an injunction in the above suit, and on hearing the same Sept. 8, an absolute injunction, to take immediate effect, was granted against the said O. S. Garretson, restraining him from manufacturing and vending the said Blind Hinges."

Nails are generally quoted \$3.75, though some brands are held at \$3.85. An order for any considerable quantity could easily be placed at \$3.70, or perhaps less. The stock is very light, as the production is curtailed, as it has been for some time, very few, if any, of the works running anything like their full capacity. Some of the largest manufacturers are very short of Nails. The demand is fair, a good many small buyers ordering, while jobbers are ordering quite freely.

Horace Durrie & Co., Eastern agents for the Ohio Butt Co.'s goods, quote us the following prices, to take effect Thursday, Sept. 17:

Narrow, Fast Joint (old list)	dis. 35
Broad, Loose Joint	50
Broad, Loose Joint	50
Loose Pin, Reversible, Panel Pattern	50
Loose Joint, Drilled, Japanned Acorns	55
Loose Joint, Drilled, Japanned Acorns	55

There is great confusion in the prices of Apple Papers in this market. They are held at full prices by some houses, while others quote \$7. We know of the Union and Sheiton being quoted \$6.50.

The firm of Rashcoe, Miller & Co., St. Louis, have failed after an existence of about fourteen months. They have, in effect, offered their creditors 75 cents on the dollar. A committee has been appointed by the creditors to investigate and report.

George B. Walbridge, agent for Sidney, Shepard & Co., has handed us the following reduced list prices on certain goods of their manufacture:

WATER CARRIER FIXTURES—Per gross.			
Covers.	Rims.	Bottoms.	Ears. Complete.
\$4.50	4.75	13.50	40c. 23.75
CHAMBER PAIR FIXTURES—Per gross.			
Covers.	Rims.	Bottoms.	Ears. Complete.
No. 1	\$4.50	10.50	75c. 27.50
No. 2	6.50	12.50	75c. 31.50
No. 3	8.50	13.50	75c. 35.50
SLOP JAR FIXTURES—Per gross.			
Covers.	Rims.	Bottoms.	Ears. Complete.
\$13.50	15.00	18.00	1.50 42.00

Sargent & Co. quote Bright Wire Goods,

pages 186 to 198, inclusive, of their catalogue, discount 70% to 10% per cent., cash. The goods embraced by this quotation are Cornice and Gate Hooks and Eyes, Screw Eyes and Screw Hooks.

Prescott Allen, for some years connected with Dunbar, Hobart & Whidden, Tack manufacturer, and lately manager of their New York store, died on Tuesday last of consumption. He was widely and very favorably known, and his death will be deeply regretted by a wide circle of friends in the trade.

The Brass manufacturers held a meeting to-day (Wednesday), but adjourned without making any change in prices.

The Francis Axe Company, Buffalo, N. Y., quote their goods for the fall season at the following reduced prices:

Chopping Axes—Ridge Bit, Bronzed.	
Ex. Light, 3 1/2 to 4 1/2, and under	per doz., \$12.00
Light, 3 1/2 to 4 1/2, 4 to 5, 4 1/2 to 5 1/2	" 12.00
Medium, 4 1/2 to 5 1/2, 4 1/2 to 6—\$1 advance over Extra Light.	" 12.00
Heavy, 5 to 6, 5 1/2 to 6 1/2—\$1.50 advance over Ex. Lt. Axes with double portion of steel	\$1.50 extra.
Beveled Axes	50c. per doz. extra.
Hafting, Scoring, Wedge, Firemen's and other styles as desired made to order.	
Double Bitted Axes.	
Light, 4 to 5 lbs.	net, per doz., \$21.00
Medium, 4 1/2 to 5 1/2	" 22.00
Heavy, 5 to 6 lbs.	" 23.00
Double Bit, Beveled	net, \$1 per doz. extra.
Handled Axes	per doz. net, \$14.50
Our seconds are stamped "J. Russell," and sold at 75 cents per doz. less than above.	

<i>Hatchets.</i>			
	Nos. 1	2	3
Cast Steel Shingling.....	\$8.00	\$8.50	\$9.00
" Lathing.....	8.00	8.50	9.00
" Claw.....	9.00	9.50	10.00
Solid Cast Steel Lth'g. Pol'shd	11.00	12.00	
Discount, 25 per cent.			

Boys' Axes and Hunters' Hatchets—Beveled.	
Boys' Axes	per doz., \$13.50
Hunters' Hatchets	" 9.00
Discount	25 per cent.
Bench Axes	3 4 5 6 less 25 %
	\$13.00 14.50 16.50 18.00

Adzes.	
House Carpenters	per doz., \$24.00
Discount	25 per cent.
Crow Bars.	
Wedge or Pinch Point	per lb., 6 1/2c.

Wedges.	
Wood Choppers' Fluted	per lb., 7c.
Hop Bars	" 12c.
Ball Drills	" 12c.
Picks—Axe Finish, Cast Steel Point.	
Railroad or Clay, 4 to 5	\$8.00, net
" 4 1/2 to 5 1/2, 5 to 6	8.00, net
" 5 1/2 to 6 1/2, 6 to 7	8.00, net
Mallets—Axe Finish.	
Short Cutter	per doz., \$16.50
Long Cutter	" 17.00
Pick Mallets	" 17.00
Discount	25 per cent.

E. E. Yates, of the late firm of T. F. Chertrice & Co., 95 Reade street, has removed to 106 Chambers street, where he is carrying on the business under the firm name of E. E. Yates & Co., as duly authorized agent for the sale of the following lines of goods, heretofore handled by the above firm, viz.: Livingston Patent Wood, Butcher and Kitchen Saws; Hawley & Leroy Patent Whiffletree Hooks, Skeins and Boxes, &c.; Rick Bros. American Bronze Iron Works, &c., &c. Their new catalogue and price list in full for the goods they represent will be ready in a few days, to which we will call attention hereafter.

We invite the attention of our readers to the advertisement on our 24th page, of the Florence Skates. We have not seen these goods, and know nothing of them beyond what is stated in the advertisement, but they are cheap, and certainly deserve the notice of the trade.

One of the best Sash Locks that has come under our notice in a long time is Garretson's Window Lock, patented Nov. 16, 1869, but only recently introduced to the trade. It is a Surface Lock that can be quickly and easily applied to a window without cutting sash or casing. It holds the window at any desired point by turning the lever, which forces a large headed bolt out against the window strip and holds the sash securely. Although thoroughly effective, these Locks are extremely simple in construction, having no springs, or other delicate mechanism liable to get out of order. They are manufactured by the patentee, J. G. Garretson, Buffalo, N. Y., and are put up in paper boxes at the following net prices:

Coppered	per gross, \$ 6.00
Japanned	" 7.00
Brass	" 18.00
Silver Plated	" 24.00

An illustration of this invention will be found in advertisement on page 24.

We invite the attention of the trade to the advertisement of W. S. Tyler, Cleveland, Ohio, on page 2, manufacturer of Bessemer Steel Wire Cloth, Riddles, Screens, &c., for foundry and other purposes. The advantages of Steel Wire Cloth over ordinary Wire is already fully appreciated by the principal railroads of the country, who are using it for locomotive spark guards and other purposes. For smut cloth it is bound to supersede iron, its finer finish and harder nature giving it greater durability and freedom from clogging than is possible in cloth made of iron wire. These goods, which have been before the trade less than two years, have already found a market in all the principal cities East and West. Notwithstanding the known superiority of the material used in their manufacture, they are offered to the trade at the same price as goods made from common iron wire.

BRITISH IRON MARKET.

(Specially reported by cable for The Iron Age.)
WEDNESDAY, Sept. 16, 1874.

Scotch Pig.—Although the market has been irregular during the week, prices fluctuating in both directions, it now rules steady, and there is a good business doing. The following are makers' prices:

Garthside No. 1	108/6
Coltshe No. 1	108/6
Glennbrook No. 1	91/7
Eglinton No. 1	86/6

Manufactured Iron.—The market is quiet, with an improving demand, and a fair amount of business is transacting. Prices, however, are declining, and Best Staffordshire Bars are now quoted £10. 10/ @ £11.

Rails.—The Rail market continues active. Prices are steady under an improved demand, and we repeat last week's quotations for Welsh, viz., £7. 10/ @ £7. 15/.

IRON.

American Pig.—During the week sales of over 1000 tons of the best L-high brands have been made at \$30 for No. 1 Foundry, and \$28 for No. 2 Foundry. These are now the asking prices. There is no improvement in the demand, and the prospect is gloomy. The production of Pig Iron does not seem to have been reduced in anything like the same proportion as the demand, and we hear of more furnaces going in than out of blast. We quote for best Lehigh brands, No. 1 Foundry, \$30; No. 2 Foundry, \$28; Gray Forge, \$25 @ \$27.

Scotch Pig.—Owing to the very low stocks here, and the small quantity of iron on the way, holders are obtaining the following prices: Eglinton, \$35; Glengarnock, \$37 @ \$38; Carnbroe, \$36 @ \$37. The sale is altogether of a retail character, and any considerable quantity of iron thrown on the market would not command such prices.

Bars.—We can still quote Bars firm at 3c. base. There is but little appreciable change in the demand, the outlook being certainly no worse than for the past two or three weeks, while, if anything, the tone of the market is more hopeful. The disposition of mill owners seems to be strongly in favor of reducing production, rather than reduce price, a policy which, in the present unremunerative state of the market, would seem to be eminently wise. A few large contracts for Bars are being hinted at by railroad companies, but as yet nothing definite has been placed on the market.

Rails.—We hear of nothing new, and continue to quote \$48 @ \$50, gold, for Welsh, and \$55 at works for American.

Old Rails.—The price is very unsettled; \$32.50 would certainly buy, and we hear less prices spoken of. There has been no business. English prices would make Old Rails cost to import several dollars above present prices here. We quote, \$32.50.

Scrap.—The market has been very quiet, and the sale of 600 tons, deliverable at New Bedford, at \$36, is all the business that we hear of. We quote nominally \$35 from yard for No. 1 Wrought.

METALS.

Copper.—The market has been fairly active at 21c. for Lake, at which figure between 300,000 and 400,000 pounds changed hands, mostly spot and some deliverable next month, purchased by both dealers and consumers. There has been no outside speculation. Holders ask 21 1/2c.; at 21c. there are plenty of orders from consumers. Baltimore, with light dealings, is worth 21c. The latest cable advices from London are dated 14th instant, when Best Selected stood £28, and Chili Bars, £79. Our West Coast correspondence is to hand, and reads as follows:

"VALPARAISO, Aug. 14, 1874.—Copper.—Direct telegraphic communication with Europe was officially opened here on the 9th instant, since when we have had private dispatches two days old, Chili Bars being quoted £76. There being a lack of vessels on this side, and freights being on the rise, holders of Copper in bars have been unable to maintain the figure of \$16.25 on shore here, and have been compelled to lower their pretensions to \$16 per quintal, at which they have succeeded in running off during the fortnight 3530 quintals. As regards Coast brands, with a steamer freight secured, prices have been upheld at \$16.50 on board, and there were sold at this 300 tons Lota, 50 Lambert, and 100 Urmeneta, and at the close there are more buyers at this figure. The offerings of Regulus are light, and \$6.92 1/2 per quintal, on board, had to be paid for a cargo. No sales of ore for export; a lot of 27,000 quintals was distributed among local smelters at \$2.85. Sales of bars sum up 13,486 quintals, at between \$16 and \$16.50 per quintal; 10,300 quintals Regulus at \$6.92 1/2, deliverable at Carrizal. Closing quotations: Bars on shore here \$16, offered; Urmeneta and Lota, with 60/ steam freight, \$16.50 on board, offered; Regulus, 50 per cent., \$6.92 1/2 on board, with sales, and ore, 25 per cent., \$2.85 on board, with sales. Exchange, on London, 60 days' sight, 44 1/4 @ 44 1/2; 90 days', 44 1/2 @ 44 3/4." No change has yet been effected in the quotations of manufactures of Copper; in our next we shall report the new rates that may have been agreed upon. We quote, nominally, New Sheeting, 30c.; Bolts and Braziers, 32c. @ 33c.; Bronze and Yellow Metal, 22c. @ 23c.; and Yellow Metal Bolts, 30c., net cash.

Tin.—Imports of Straits Tin are falling off in this market, while stocks of English, both Common and Refined, are running quite low. The consequence has been an improvement in value of 1/2c. since our last report, notwithstanding the fact that the transactions have been but limited in extent. The market is strong at the following quotations: Straits 21 1/2c., gold; English Refined, 21 1/2c.; L. and F., 21 1/2c.; and Banca, 25c. @ 25 1/2c., all gold. Accounts from London per cable are most encouraging, there having been a rise of £3 during the week; Straits there commands as per today's cablegrams £94; English Refined, £100; and L. and F., £93. SINGAPORE, Sept. 15.—Malacca Tin firm at \$24.50 per picul. The Dutch market had, after a smart decline, settled down to 57 guilders, spot, and 56 1/2 @ 56, futures, on the 1st instant, and we presume that the turn has been brought about by the demand for actual consumption, especially in England. We mentioned in former reports that the consumptive inquiry in Europe was steady all along. Tin Plates remain inactive in our own mind, and we have but to repeat our previous quotations: I. C. Charcoal, \$9.87 1/2 @ \$10.50, gold, per box; I. C. Coke, \$7

cipally from Bohemia, having advanced from £1,290,299 in 1865 to £1,857,745 in 1870."

IRON AND STEEL INSTITUTE MEETING.

To-morrow the autumnal session of the Iron and Steel Institute will be inaugurated at Barrow-in-Furness. A very interesting series of visits and papers will be got through during the week, the programme being set out as follows: On Tuesday, Sept. 1st, at 2 p. m., there will be a meeting of general council. Members will on this day be able to visit the works named in this programme. On Wednesday, Sept. 2nd, at 10.30 a. m., general meeting in Town Hall, at which the mayor of Barrow, J. T. Smith, Esq., will open the proceedings. Scrutineers for the voting papers will be appointed. The council will present a list of their retiring members, and will submit various recommendations. A selection of papers will be read and discussed. 1.30 p. m.: Members will visit the works of the Barrow Hematite Steel Company. 5 p. m.: The members will be entertained at dinner by the Barrow Hematite Steel Company (morning dress). At 8 o'clock a special train will leave for Whitehaven after the dinner. In cases where tickets are not forwarded previous to the meeting, members will find the invitation cards in the reception room. On Thursday, Sept. 3rd, at 10.30 a. m., General meeting in the Town Hall for the reading and discussion of papers. 1.30 p. m.: A special train will leave leaving crossing near Town Hall for Askam and Millom. (1) Those having tickets for Millom will proceed to the Millom Iron Works and Hodbarrow Mines. Luncheon will be provided by the Cumberland Iron Mining and Smelting Company, Millom Iron Works, and the Hodbarrow Mining Company. (2) Those having tickets for Askam will be put down at that station, and will visit the Askam Iron Works and M. nes, Park Mines, Roanhead Mines, &c. Luncheon will be provided by the Furness Iron and Steel Company, at Furness Abbey. Members will be conveyed back by special train, and, if time permit, the Stank Mines will be visited in the reception room. These excursions will be found in the reception room. On Friday, Sept. 4th, there will be an excursion to Cumberland Iron Works and Mines. A special train will leave Barrow at 9 a. m., and will pass through the Cumberland hematite district, Cleator and Frizington, to Workington and Maryport, returning by Harrogate to Whitehaven, where Lord Londale will entertain the members to luncheon in the afternoon. The details of this excursion will be announced at the meeting. Special programmes will be issued on Wednesday and Thursday mornings.

The following is a list of papers that have been promised: "On the Rampside Boring, near Barrow," by Mr. Alexander Brogden, M. P., Ulverston; "On Mechanical Puddling," by Mr. T. R. Crampton, London; "On Rolling Mill Machinery Arrangements in America," by Mr. A. L. Holley, New York; "On Improvements in Setting Bessemer Converters," by Mr. A. L. Holley, New York; "On Valves Suitable for Working Hydraulic Machinery," by Mr. Robert Luthy, Bolton; "On the Iron Ores of Sweden," by Mr. Charles Smith, Barrow; "On Ironstone Mining in the Cleveland District," by Mr. A. L. Stevenson, Durham; "Description of the Latest Bessemer Process," by Mr. B. Walker, Leeds; "On a New Form of Blast Furnace," by Mr. T. Wrightson, Stockton-on-Tees; "On the Geology of the West Coast Iron District," by Mr. P. Wurzburger, Dalton-in-Furness.

The Corporation of Barrow have kindly placed the Town Hall and council chamber at the service of the Institute for the purpose of the meeting.

The special trains referred to will be provided by the Furness Railway Company free of charge, and members will be allowed to travel on that line during the meeting on production of their tickets.

The following works will be open to the inspection of members, except during the time when the business meetings are being held in the Town Hall: Carnforth Hematite Iron Works; Barrow Hematite Steel Works and Mines; Barrow Hematite Steel Works and Mines; New Furnaces; Barrow Shipbuilding and Engineering Works; Barrow Flax and Jute Works; Mr. S. J. Clays's Railway Rolling Stock Works; Barrow Docks, Warehouses and Dredging Machinery; Mr. J. W. Woodhouse's Patent Brick Works; Barrow Wire Works; Messrs. Westray & Forster's Engineering Works; Mr. Woodall's Boiler Works; Barrow Steam Coal Mills; Askam Iron Works and Mines; Messrs. Kennedy Bros. Mines; Messrs. Harrison, Ainslie & Co.'s Charcoal Iron Works and Mines, Ulverston; Mines of the Ulverston Mining Company; Millom Iron Works; Hodbarrow Mines. The mines and works that will be open in the Cumberland district will be given in detail at the meeting. Facilities will be afforded for the exhibition of objects of interest to the iron and steel trades.

A NEW COAL CUTTING MACHINE.

"A trial," says the *Iron and Coal Trades Review*, "of coal cutting machinery took place recently at Haddington, near Edinburgh, when several apparatus were tried, and it may not be uninteresting to give a few details of the successful machine, which did some really good work. In response to the invitation of the Haddington Agricultural Society, a number of coal cutting machines were publicly tested on masses of coal built and bolted together to resemble as closely as possible the face of a coal seam. Among the competing machines was one which had just been patented and completed in time to be sent in haste to the show. It had, consequently, never been in a mine. The motive power employed was a compressed air at 35 lbs. per square inch, which put in motion a small horizontal engine lying along a wagon. The fly-wheel shaft was placed vertically, in order to communicate its motion by means of bevel wheels to a horizontal bar, held on bearings underneath, and projecting about 3 ft. 6 in. on one side. This bar had a deep square thread cut on it and a groove along each side, which served to carry two rows of steel cutters. Before starting to work, this cutter bar was swung round underneath the wagon, and set in revolution by starting the engine. The bar was brought steadily back to its original position at right angles to the wagon, by which time it had cut into the coal to a depth of three feet. The wagon was then set in motion, and the revolving bar continued to work in a manner similar to a slotting drill, the square thread serving to draw out the cutting so as to avoid clogging. This novel machine underwent 60 feet of coal in one hour (or one foot per minute), the depth of the coal being three feet, and the width of groove rather less than three inches—and it thereby secured the first prize and gold medal of the society—having defeated the nearest competitor by nine feet. The trial took place in the presence of 20,000 spectators, and under the close inspection of many of the principal Scotch coal-owners and colliery managers, who expressed themselves so well satisfied with the great superiority of this machine that they agreed to defray the expense of long and exhausted trials underground, with a view to its general adoption. A similar machine has recently been sent to Saxony, where it is now at work in a quarry undercutting sandstone. This ingenious apparatus is the invention of Messrs. Warsop & Hill, who have also patented an equally novel rock drill for mining purposes, which, besides being extremely simple and portable, will do

its work with compressed air at the unusually low pressure of 14 lb. per square inch. The Warsop rock drill imitates the operation of hand boring, in so much that the boring chisel remains with its point against the rock, whilst it receives a rapid succession of blows from an air or steam propelled hammer of perfectly uniform force, and of a weight carefully adjusted to suit the endurance of the steel point."

THE DANKS' PUDDLING.

A correspondent of the *Sheffield Telegraph* furnishes some information about Mr. Danks' mechanical puddling, which—stripped of some redundancy—is of interest. He says: "Re-assuring information is forthcoming as to the operation of Danks' rotary puddling machines, which Messrs. R. Heath & Sons have again at work at their Ravensale Iron Works, North Yorkshire. When, by an accident alike to the squeakers and the steam hammer, they were stopped, there was a difficulty in rolling plates, in which Danks' iron had been used, free from blisters and cracks. Some extra attention, however, to certain of the practical details remedied all this, and now 'best best' plates are being rolled from iron puddled with Danks' furnaces, and only once heated after it has passed through the forge rolls; thereby avoiding the very frequent re-heating necessary when the puddling is done in the ordinary puddling furnaces. Heavy plates are being manufactured also without resort having to be had to the doubling process previously indispensable. In the Danks' furnace enough iron can be produced at one heat to make a plate of from seven to nine cwt.; whereas, under the old hand system, at least, from eight to ten separate heats have to be worked together to produce a pile of iron to roll a plate of similar proportions. Messrs. Heath are understood to be in every way satisfied with the working principle, and to greatly prefer it to the Crampton furnace, which has been set on at Woolwich, and in favor of which the Danks' furnace is being abandoned at the Carlton Works, in the North of England. Nor are the proprietors of Hopkins, Gilkes & Co., Middleborough, less confident than Messrs. Heath of the value of Danks' machinery. They keep six furnaces in constant action, and the iron turned out is in every respect of excellent quality. At the last-named works the efficiency of the machinery is promoted by the insertion of a water-box between the furnaces and the fire-places, and by the forcing of the fire through tuyers to the bottom of the molten metal as it revolves with the furnace. This has been effected by the ingenuity of the manager (Mr. R. Lester, formerly of Wolverhampton), who has patented the application of the tuyeres and the water-box to the working of the Danks' furnace. By the use of the tuyeres the distribution of the heat is much more uniform than heretofore, and the water-box prevents much destruction to brickwork. At the same time, neither at the Carlton nor at the Eremus Works has the Danks' furnace worked to the satisfaction of the proprietors; but the inventor is understood to object to the way in which his principle has been applied at these places; and on the premises of the Carlton Company some time ago, by the working of one furnace which he took under his immediate supervision, showed that if his principle in its integrity should be adopted, the furnaces could be worked as successfully as they are now running at the forges of Messrs. Hopkins & Gilkes and of Messrs. Heath. Resulting from what was said at the last meeting of the Iron and Steel Institute, it is assumed that at the Eremus Works the Danks' process will be replaced by a method which the manager (Mr. J. A. Jones) believes to be altogether superior to both the Danks and the Crampton. Though not yet adopted in South Yorkshire, yet a first-class iron making firm there has taken steps which, when they do begin, will leave little or no doubt as to their ultimate success. Something like the Crampton principle was experimented with about two or three years ago in the Wednesday neighborhood, but was eventually abandoned. Messrs. Hopkins, Gilkes & Co. do not show any prejudice as the result of their recent working of the furnaces; but it is believed that no better state of things would have been shown under the old process, while the outlays which have been necessary in relation to the new are likely to insure considerable profit in the future."

THE SCOTCH PIG IRON MARKET.

Since the date of my last letter the Scotch pig iron market has been very dull, and few transactions of any importance have been entered into. This has been the natural result of an increased production, there being now 110 furnaces in blast, not altogether unaided by the dullness of the shipping demand. The following merchants' circular speaks for themselves, and record the course of the market since my last report: Messrs. Wm. Colvin & Co. (Glasgow), Aug. 26th, say: "The warrant market has been exceedingly dull during the past week. The opening price on Wednesday was 88¹/₂, from which point a gradual decline took place until on Monday forenoon 80¹/₂ was accepted, but at this point the price rallied to 82¹/₂ and was freely paid that afternoon. To-day the market has been rather dull, and business has been done from 81¹/₂ to 80¹/₂, closing with sellers at that price, and buyers offering 80¹/₂. The prices of makers' iron are all lower, as will be seen from the subjoined quotations:

Deliverable alongside.		No. 1.	No. 3.
G. M. B., at Glasgow	87 ¹ / ₂	87 ¹ / ₂	87 ¹ / ₂
Gartsherrie, "	110 ¹ / ₂	110 ¹ / ₂	110 ¹ / ₂
Coltness, "	112 ¹ / ₂	112 ¹ / ₂	112 ¹ / ₂
Summerlee, "	107 ¹ / ₂	107 ¹ / ₂	107 ¹ / ₂
Carnbroe, "	94 ¹ / ₂	94 ¹ / ₂	94 ¹ / ₂
Monkland, "	90 ¹ / ₂	90 ¹ / ₂	90 ¹ / ₂
Clyde, "	90 ¹ / ₂	90 ¹ / ₂	90 ¹ / ₂
Govan, at Broomfield	90 ¹ / ₂	90 ¹ / ₂	90 ¹ / ₂
Laigloan, at Port Dundas	112 ¹ / ₂	112 ¹ / ₂	112 ¹ / ₂
Calder, "	111 ¹ / ₂	111 ¹ / ₂	111 ¹ / ₂
Gleagarnock, at Ardrossan	95 ¹ / ₂	95 ¹ / ₂	95 ¹ / ₂
Eglington, "	87 ¹ / ₂	87 ¹ / ₂	87 ¹ / ₂
Dalmellington, "	88 ¹ / ₂	88 ¹ / ₂	88 ¹ / ₂
Arron, at Greenmuth, selected	107 ¹ / ₂	107 ¹ / ₂	107 ¹ / ₂
Shotts, at Leith	107 ¹ / ₂	107 ¹ / ₂	107 ¹ / ₂
Kinnell, at Bo'ness	90 ¹ / ₂	90 ¹ / ₂	90 ¹ / ₂
Bar Iron	£10	£10	£10
Nail Rods	10	10	10

Messrs. James Watson & Co. (Aug. 26th) advise as under: "The decline in our Scotch pig iron market, noticed in our last weekly report, has continued until to-day, when 79¹/₂ cash was accepted, and we close nominally at 79¹/₂. Shipments last week were 7018 tons against 10,015 tons in the corresponding week of 1873. We quote:

		No. 1.	No. 3.
G. M. B., at Glasgow	86 ¹ / ₂	86 ¹ / ₂	86 ¹ / ₂
Gartsherrie, "	111 ¹ / ₂	111 ¹ / ₂	111 ¹ / ₂
Coltness, "	111 ¹ / ₂	111 ¹ / ₂	111 ¹ / ₂
Summerlee, "	106 ¹ / ₂	106 ¹ / ₂	106 ¹ / ₂
Laigloan, "	111 ¹ / ₂	111 ¹ / ₂	111 ¹ / ₂
Carnbroe, "	111 ¹ / ₂	111 ¹ / ₂	111 ¹ / ₂
Calder, at Port Dundas	111 ¹ / ₂	111 ¹ / ₂	111 ¹ / ₂
Gleagarnock, at Ardrossan	96 ¹ / ₂	96 ¹ / ₂	96 ¹ / ₂
Eglington, "	86 ¹ / ₂	86 ¹ / ₂	86 ¹ / ₂
Dalmellington, "	86 ¹ / ₂	86 ¹ / ₂	86 ¹ / ₂
Shotts, at Leith	106 ¹ / ₂	106 ¹ / ₂	106 ¹ / ₂
Kinnell, at Bo'ness	92 ¹ / ₂	92 ¹ / ₂	92 ¹ / ₂

The Scotch shipbuilding industry is growing worse week by week, no fewer than 2700 men having been discharged from the Clyde yards last week. Wages have also been reduced about 30 per cent. One of the latest launches on the Clyde was that, last week, of the State of Indiana (a fine addition to the State Line), from the yard of Messrs. Thomas Winge & Sons, Glasgow. She is 330 ft. long, 36 ft. beam and 28 ft. 6 in. deep. Her tonnage is 2126 B. M., and her engines are 1750 horse-power. She was launched with her engines and boilers aboard.

TRADE OF SHEFFIELD.

The trades of the Cleveland, Lancashire and Barrow districts present no new special features, so that I pass them over and proceed to deal with the "state of things" industrially. At Sheffield, I may say that there are still no great changes to record, and there is yet a marked absence of stirring business events, but it is a marked feature of the week, and one of the most interesting in things, seeing that more orders for several classes of goods are coming from foreign markets. A good deal of interest was created on Friday by the publication of the statement that the Spanish government, or rather, the Bilbao municipality, had decided to impose a tax of 5d. per ton on all iron ore shipped thence; but it has been ascertained on inquiry of those interested, that during the war the English shareholders had agreed to pay a proportion of the expenses incurred in defending their property from the Carlists. If, therefore, the tax be only levied for that special purpose, and only collected during the struggle, the British vested interests are not likely to suffer heavily, nor will those of the Bilbao municipality. The Spanish government should manifest a desire to continue the tax, it will be necessary to invoke diplomacy in order to bring it to an end. At present, it may be said, both sides have shown a disposition to respect British interests, but the trade has naturally suffered severely by the abstraction of the labor necessary to carry on the mines. The blast furnaces of Messrs. John Brown & Co., Limited, have received notice of a reduction of 10 per cent. in their wages, to take effect on the 29th inst.

It has already been recorded that the strike of miners in South Yorkshire and North Derbyshire had been disposed of—with the exception of Earl Fitzwilliam's men—by the men returning to work at a drop of 10 per cent., leaving the other 2½ to arbitration. This arbitration was conducted in London on Thursday last, and it was decided that the additional 2½ per cent. reduction on the gross wages be made on the next pay day, the settlement on that basis not to be disturbed during the ensuing three months. Earl Fitzwilliam's men hardly find themselves in so good a position. His lordship has throughout insisted upon the full drop of 12½ per cent., which the men refused to accede to. Now that the arbitration supports their employer's view, the miners have indicated their willingness to resume work, which they can only do, they are informed by the earl's manager, by allowing 8 lb. of shale per cwt.—28 lb. of the iron instead of 22 lb., as before—and by signing agreements to give up possession of their houses belonging to his lordship at one week's notice. These conditions have taken the men aback, and up to the time of writing they have manifested no willingness to resume operations. It is stated, although I cannot absolutely vouch for the accuracy of the information, that Earl Fitzwilliam is induced to be thus firm with the miners because he is now supplying, under contract, the Messrs. Dawes-Milton and Elsecar Iron Works—with best coal at 5 6 per ton, or less than can be raised for.

In the coal trade generally there is a moderate business doing, but competition is becoming more active, owing to the large output and comparatively small demand. Good house coal is being delivered in Sheffield at 14 to 16 6 per ton, and steam coal is readily obtainable at 11 to 13 per ton. It is rumored that the price at which the Dodworth Silstone Colliery Company has contracted to supply the Bradford Corporation with 30,000 tons of Silstone coal, is at 13 per ton, including carriage, which is 2 3 per ton, and 45 for No. 3. Bessemer-Millom hematites are ordinary No. 3, 90; No. 4, 87 6; M and W, 105; Millom-Bessemer, No. 1, 95; No. 2, 92 6; and No. 3, 90 per ton, with the usual 2½ off for prompt.

Much as has been said and written about the possibilities of active American competition in the finished iron trade, both on the Continent and in some distant markets, it would appear more than probable that the struggle will first fall in the Bessemer steel trade. The United States possesses almost limitless deposits of fine hematite iron ores, in addition to an enormous supply of coal, so that with the growing American inquiry for the use of this material, we may expect to notice a corresponding development of the native means for producing it. I do not need to cite facts in support of this theory, seeing that your own collieries and iron works, frequently to record facts which show that the United States is in this respect, sooner or later, be self-supplying, seeing that the process is mainly a mechanical one, and that you have all the materials ready at hand. By this I do not mean to infer that your manufacturers are deficient either in enterprise, tact or knowledge, but I take it to be a fact that they are deficient in mechanical manipulative and inventions, and they will sooner make their skill pay in that respect than in any other.

In the face of our falling markets it is thought very improbable that you will at present be able to oust us, our figures for steel rails delivered from Liverpool being no higher than £10. 10. to £10. 15 per ton. These low figures may be taken to be the combined result of lower wages, cheaper fuel and the reduction in raw materials. As an instance of the last-named drop, I may state that spiegeleisen is now obtainable at fully 40 per cent. less than its last year's price, hematite pigs at 30 per cent. lower, and coal at 50 per cent. less. By these means, as before related, Bessemer material can be turned out at figures which are strikingly below the quotations of 1873, and rails can, by a further economy effected by rolling for "hogging" instead of hammering, be sent forth at 33 per cent., or so, under the selling prices of that period. There is admittedly a growing competition in the trade; but it must be, and is being, met in the best possible manner.

Some of the cutlery branches are feeling a trifle better in consequence of an improvement in the inquiry for secondary qualities of table and kitchen goods for export. The American merchants and factors are not doing much, but I hear of a better call from some of our colonies and Northern Europe. India is sending us a few fairly good orders for edge tools, as also, are Australia and New Zealand, whilst the Cape of Good Hope furnishes good orders for tables, saws, cutlery of a common description, and miscellaneous Sheffield wares.

BIRMINGHAM HARDWARES AND STAFFORDSHIRE IRON.

Business in the hardware industries of Birmingham and the surrounding districts continues quiet, transactions for foreign export being on a very light scale. The home and colonial demand is of very fair proportions, and is the only sustenance of the trade at present. Shelf ironmongery, kitchen goods, lamps, chandeliers, gas fittings and hollowware meet with the readiest sale. For some of these articles there is a steady inquiry from the United States, the same being the case for locks and curry combs. The iron tube manufacturers have rather more work, but the association having been broken up prices are stated to be cut very fine indeed. Malleable iron castings, wrought kettles and buckets are moving off at an accelerated rate,

and the sale of bedsteads, locks and jewelry is generally on a much more satisfactory footing than it has been of late. There are a few reductions in hardware prices; shoe heels are reduced 5 to 10 per cent., cables and large sized chains are about 1 to 2 easier (short link chain being now 22 to 30 per cwt. delivered in Birmingham), and sheet iron goods are a little lower. The iron trade meetings of last week at Wolverhampton and Birmingham were a little better in tone, and there were a greater number of orders placed—albeit they were of limited size, and mainly in satisfaction of local requirements. The iron works of the district are, as a rule, only in partial operation, but a good many additional furnaces are being re-lighted, mainly in the expectation that at the termination of the current quarter there will be a drop in wages sufficient to give a considerable impetus to trade. Finished iron prices remain firm on the basis of £12 for best bars. Common bars are £10 to £11; hoops, £11. 10 to £12; and sheets £13 to £14. These figures can, in most instances, be shaded a little.

SOUTH WALES.

The iron trade of the principality does at last appear to be improving. One token of this is that at Cyfarthfa two mills are at work, a manifest sign that Mr. Crawshaw is beginning to be able to secure orders. Still better is the report that at Plymouth all the forges and mills are in operation; that at Abernethy two furnaces are in blast, and a large section of the mills and forges are running, and that Dowlais is fairly active at both the old and new works. Ebbw Vale Works are busier, but the contracts now running have been taken at low figures—as an example, of which it is stated that these works are now producing 12,000 tons of steel rails for the North and Brecon Railway at £9. 10—fully £7. 10 less than the quotations of six months ago. The iron plate manufacturers are arranging a uniform wages rate for the whole district, the trade being somewhat brisker than it has been recently.

THE METAL MARKETS.

Metals, as a whole, have been fairly firm since my last letter, and there have been a good many transactions in copper and lead. Messrs. Von Dadelzen & North report that Chili bars have been in demand. Importers have met buyers freely at £76 to £76. 15 for g. o. b., cash, and £77 for arrival. Market closes firmly at the best. A considerable amount of Walaraos has been done at £87. 10; Burma, £86. 10; English steady. Tin dull, and easier. Straits has been sold to a moderate extent, at £93 down to £91, and Australian at £92 to £90; fully 150 tons done at the lower figure. English is obtainable at 20 to 30 decline on last week's rates. In Holland, Banca sold at from 57½ fl. to 57½ fl.; Bilton, 54½ fl. Tin plates dull; fair cakes obtainable at £7. 6. Lead steady; £21. 5. Spelter sold at £22. 5. Quicksilver nominal; importers not selling.

Messrs. Kelly & Co., August 27, says, in reference to minerals, that the market is still in a disturbed condition, because the normal value of fuel has yet to be established. Manufacturing coal is now considered as cheap enough; native iron stone is plentiful and rather cheaper, its normal value probably reached; copper and lead ores not abundant; black tin ore, the best, first-class manganese ores and pyrites in request; antimony, zinc and chrome iron ores scarce; lime phosphates, of high standard, in increasing demand, and in short supply; an interesting fact of 80 per cent. phosphoric, 3 to 14 feet thick, in Nassau, is reported; marketable sulphur is said to be obtainable in Iceland at £3 a ton, against nearly twice that sum in Sicily, and £4. 12 in Spain; important discoveries of cinabar in California have again been announced, which, if true, will sensibly lower the price of quicksilver. China clay, 42 to 45; phosphates of lime, ordinary, 60 per cent., 1/2; 90 per cent., 1 4 to 1 5 per unit; Bolivian, £6. 15; Canadian, 80 per cent., 1 4 per unit; Estremadura, 1 3 to 1 5; Curacao guano, £6. 2 6 U. K., and £5. 5 to £7 Continent, 70 per cent.; chrome ores, 26 to £3; copper ores, 14 8 to 15 1 the unit; iron ores, red hematites, British, 27 to 30; Spanish, none; burnt iron ores, 60 per cent., 6d. the unit; manganese ores, 70 per cent., 14d. to 15d.; pyrites, cupreous, 8½d.; noncupreous, 10d. the unit; antimony ore, £10 to £12.

Messrs. French and Smith, August 27, note that copper is rather firmer, but with few transactions. Tin continued steady until yesterday, when 100 tons Australian tin were put upon the market, and sold at £90, being a fall of £1. 10 per ton. English is, consequently, easier. Banca, £98 to £100 per ton; Bilton, £94; Straits, fine, £91 to £93; Straits, alloy or forward, £91; Australian ingot, £90; English refined, £97; English, common bars, in barrels, £97; English, common blocks and ingots, £98 per ton. The plates firm. Charcoal, I. C. 36, 41 per box; coke, I. C. 28 6 to 37 per box. Lead steady. Spelter scarce. Quicksilver is £1 per bottle dearer.

The Mining Journal (August 29), thus reports: "Copper.—The market during the week has been much stronger. On Monday Chili bars, g. o. b., quoted £76, cash; Wallaroo, £87. 10; and Burma, £86. 10. On Tuesday Chili bars g. o. b. changed hands at £76. 10, cash; Burma, £86; English, steady; tough, £83 to £84; best selected, £84 to £85; India 4 by 4 sheets, £90. Wednesday: Chili bars, Lots, to arrive, two months, sold at £76. 15, and 180 tons T. A. Edwards at £76. 15, cash; g. o. b., £76. 10, cash. Thursday: Market firmer; 300 tons Chili bars, Lots, to arrive, sold at £77, cash; 25 tons picked brands, at £77. 10, cash; 110 tons Uruceta runmed sold at £76. 15; Wallaroo changed hands at £87. 10. To-day market very strong; Chili bars, principally held in Liverpool; sales at £77 to £77. 10. Lead.—There is no alteration to report in this metal, which continues firm, sellers declining to accept less than £21. 5 for good soft English. Spanish, without silver, £20. 15. Spelter.—We cannot advise any improvements in this metal, which is still dull, Silesian being quoted £22. 5, with very little inquiry. Quicksilver.—Market firm at £23 per bottle. Tin.—Straits Tin sold on Monday at £93, quiet market. Tuesday, £93 to £93; Australian, £91. 10 to £92; English ingots, £97 to £98. Wednesday: Still a downward tendency; Straits, £92; Australian, £90 to £91. To-day Straits very flat, and rather pressed for sale; Straits have been bought at £91. This has affected English, which is quoted £2 per ton under our last quotation. Banca, £98; Australian, £89. Tin Plates.—Market very quiet."

Plate Glass Manufacture in England.

The manufacture of plate glass, as now conducted by the Thames Plate Glass Company, at Blackwell, London, is as follows: The principal successive operations necessary to convert a mixture in the pot into a finished sheet of plate glass are six in number, and may be described under the heads of melting, rolling, annealing, grinding, smoothing and polishing. The pots are of Stourbridge clay, made on the premises, and are filled with the mixture, the chief ingredients of which are silica, sand carefully dried, lime, sulphate of soda, broken white glass and a little arsenic. The sand is obtained from Germany. After remaining in the furnace for about sixteen hours the contents of the pot

are fit for removal. The molten mass is then run over the surface of the rolling table and the roller passed quickly over it. The glass commences to solidify almost immediately, and while in a thick, tenacious condition, and of a rich golden tint, is rapidly transferred into the annealing furnace. The rough sheet, as it may now be termed, is taken from the annealing furnace to the grinding room. Of these there are several, containing about a dozen grinding stones, or, more properly, beds or tables, upon which the plate is laid flat. The grinding frames consist of wooden boards joined together and armor plated, so to speak, at intervals over the rolling or grinding surfaces with strips of wrought iron. These strips, when first screwed on to the frames, are ½ inch in thickness, and when removed measure less than one-eighth inch. The frames are mounted upon a spindle, and a see saw, semi-rotary movement is imparted to them by shafting running underneath the beds. They are also capable of being shifted by a simple slot connection, so as to work over any part of the surface of the sheet as required. The grinding beds are of stone and measure about 16 feet by 11 feet. The materials used as the grinding agents are coarse sand, fine sand and emery. A jet of water plays on the surface of the sheet during the whole of the operation. Between the grinding and polishing processes there is an intermediate process called smoothing, in which two sheets of glass are employed. One is laid over the other and caused to move over it in a manner similar to that in grinding. Emery is placed between the two surfaces. On entering the polishing room the attention of a visitor is at once arrested by the reddish tinge of everything, extending to the dresses of the men and women engaged therein. This is due to the use of the red oxide of iron which is the polishing agent. The sheet to be polished is laid flat on a table, so as to be perfectly flush with the edges. The rubbers are of flannel and mounted on a frame, which carries them backward and forward over the sheet. The table, at the same time, has a lateral reciprocating motion, so that the whole surface of the sheet comes successively under the action of the rubbers. The largest plates measure about 15 feet by 10 feet, and the maximum thickness is about 1½ inches. One-eighth of an inch is allowed for loss in the operations we have described. A nest of six boilers and three vertical steam engines, two of 70 horse-power and one of 60 horse-power, supply the necessary motive power.

The number of iron works in Spain, in operation in 1870, is reported as 75, with a production of 54,007 tons pig iron and 36,162 tons wrought iron, and employing 3570 men, 151 women, 453 boys, along with 154 water-wheels, representing 1549 horse-power, and 120 steam engines of 3790 horse-power. The above figures show that the production of the year 1870 has exceeded that returned for the preceding year by 125,240 tons of iron ore, 19,521 tons pig iron, and 539 tons wrought iron.

The Moorefield (W. Va.) *Advertiser* states that an extraordinary deposit had been discovered at the point where Ketterman's road crosses Middle Mountain. Several veins have been opened, all of them of extraordinary thickness and richness. The ore is taken out in immense blocks, some weighing 300 pounds, which lie wedged compactly together, but are easily separated with the crow bar. On the surface these blocks lie horizontal, and cover an area of 100 yards in width, and miles in length. Beneath the surface the blocks stand perpendicular and in veins of untested thickness, though known to be more than thirty inches.

London Metal Market.

(From The Mining Journal.)

Copper—£ ton.	£	s.	d.	£	s.	d.
Best Selected	85	0	0	87	0	0
Tough Cake & Tilt	83	0	0	85	0	0
Smelting and Sheets	80	0	0	82	0	0
Boils	78	0	0	80	0	0
Bottoms	75	0	0	77	0	0
Old	70	0	0	72	0	0
Australian	60	0	0	62	0	0
Wire	1	0	0	1	0	0
Tubes	0	1	0	0	1	0
Spelter—£ ton.	22	5	0	23	10	0
Foreign on the spot	22	5	0	—	—	—
to arrive	22	5	0	22	10	0
Zinc—£ ton.	28	13	0	28	13	0
In Sheets	28	13	0	—	—	—
in 56 lb. bottle	24	0	0	—	—	—
Tin—£ ton.	96	0	0	—	—	—
English Blocks	97	0	0	—	—	—
Ditto Bars	97	0	0	—	—	—
Ditto Refined	98	0	0	99	0	0
Banca	98	0	0	99	0	0
Belgium	98	0	0	99	0	0
Australian	83	0	0	90	0	0
Tin Plates—£ 1000.	1	16	0	nom.	—	—
Charcoal—£ qual.	2	0	0	—	—	—
IX " " " qual.	2	15	0	—	—	—
IX " " " qual.	2	15	0	—	—	—
IX " " " qual.	2	15	0	—	—	—
IX Coke	1	8	0	1	10	0
IX " " " qual.	1	8	0	1	16	0
Canada Plates	19	0	0	—	—	—
at works	18	10	0	—	—	—
Iron—£ ton.	9	5	0	9	10	0
Bars, Best in London	9	5	0	9	5	0
to arrive	0	0	0	11	10	0
Nail Rods	11	0	0	—	—	—
Sail Rods	11	0	0	14	0	0
Bars	12	0	0	14	0	0
Hoops	12	0	0	11	0	0
Flat Irons	11	0	0	11	0	0
Hoop ditto	11	0	0	11	0	0
Sheets, single	10	0	0	6	10	0
Flat Irons	10	0	0	5	0	0
Refined metal ditto	3	0	0	—	—	—
Bar, common	9	0	0	—	—	—
Best, cast, T. & C. or F.	9	0	0	8	0	0
Ditto, Railway, in Wales	9	0	0	18	0	0
Ditto, Cast, in London	17	0	0	18	0	0
Ditto, Swedish	17	0	0	18	0	0
Ditto, Cast, in London	17	0	0	18	0	0
Fig. No. 1, in Clyde	4	11	0	5	15	0
Ditto, Cast, in London	4	11	0	5	15	0
Ditto, Cast, f. o. b.	4	10	0	5	10	0
Ditto, Cast, in London	4	10	0	5	10	0
Railway rails	12	10	0	14	0	0
Indian Ch. on. Flies in Lot	10	0	0	13	0	0
Steel—£ ton.	—	—	—	—	—	—
Swedish, in Kees' rolled	19	10	0	20	0	0
Ditto (hammered)	19	10	0	20	0	0
Ditto, in forgings	20	0	0	20	0	0
Ditto, in forgings	20	0	0	20	0	0
Lead—£ ton.	21	5	0	21	10	0
English, common	21	5	0	21	7	6
Ditto, Ld.	21	5	0	21	7	6
Ditto, W.B.	21	15	0	22	0	0
Ditto, Sweet	23	0	0	—	—	—
Ditto, Sweet	23	0	0	—	—	—
Ditto, White	20	0	0	25	13	0
Ditto, Patent Slack	21	0	0	21	4	8
Spelt	—	—	—	—	—	—

* At the works, 1s. 10s. 1d. per ton less. Terce plates, per box 6s. 6d. for each A.

The Bessemer Process.

BY Z. S. DUFFEE.

The pneumatic or Bessemer process of making iron and steel consists in forcing into molten pig iron, contained in a suitable vessel called a converter, streams of air under a high pressure, and, by the combination thus effected between the oxygen of the air and the carbon in the iron, decarburizing the metal to the extent necessary to produce the desired temper of steel; the product thus made being cast into ingots or other forms, and treated in like manner as is customary in working cast steel.

The original method of conducting this process was to stop the blast when the carbon in the iron was so far oxidized and removed as to leave only a sufficient quantity in the molten metal to produce the quality of steel or iron required; and where pig iron is made with charcoal from ores containing manganese and practically free from sulphur and phosphorus, as is the case in Sweden, the above plan is now frequently pursued with very satisfactory results. Indeed, tool steel of very good quality is made in Sweden, by the above method, from molten crude iron run directly from the blast furnace into the converter.

As, however, a large proportion of iron ores contain more or less sulphur or phosphorus, or both, and, when the ores themselves are free therefrom, the mineral coals and cokes and the fluxes most largely employed in smelting them frequently communicate these injurious elements to the ores or to the metal reduced therefrom, in the process of reduction, it is found that pig iron made from impure ores, or with sulphurous coals or cokes, and all other pig irons containing any considerable percentage of sulphur or phosphorus do not, by the foregoing treatment give a valuable product; and it may be stated, broadly, that pig irons containing over one-tenth of one per cent. of sulphur, or of phosphorus, are not desirable for the pneumatic or Bessemer process, and that in the present state of the art, at least, and with the large amount of purer iron accessible in most parts of our country, it will not pay to attempt to work such.

Fortunately, the plan devised by Mr. Robert Mushet, of England, in the early history of this process, enables us to work satisfactorily such of the cheaper grades of pig iron as contain only very small portions of sulphur and phosphorus, and by its use in connection with this process over half a million tons of steel are now annually produced in Europe and in the United States from pig iron made with mineral coals and cokes.

This plan consists in adding to the metal under treatment, after it has been entirely decarburized by the blast of air, a certain percentage of a triple compound of iron, carbon and manganese, which is found as an article of commerce in the spiegeleisen of Germany and the franklinite pig iron of this country. And, by varying the quantity of this compound which is to be added in accordance with the percentage of carbon which is known to be contained therein, any required degree of carburization can be given to the metal under treatment, while the manganese in the compound, acting as a detergent or cleansing agent, removes or neutralizes the oxides, sulphurets and phosphurets existing in the metal, which would otherwise render the product red-short or cold-short and useless. There has also been introduced into this manufacture a compound of iron and manganese, containing but a small percentage of carbon, called ferro-manganese, and with it we are enabled to make a very soft weldable metal from mineral coal and coke pigs. As it is quite expensive this compound is not largely used, especially as it is not now very important to make the grade of metal in the production of which it is required.

The conversion of the molten metal by the pneumatic process is a very rapid one, 30 minutes being the longest time required for converting ten tons of the grayest pig into steel or soft iron, ready to be cast into ingots or masses of any desired form. The average duration of the blowing operation is from fifteen to twenty minutes, the time depending upon the character of the pig iron and some other conditions, and if the blowing engine is properly proportioned to the charge a large quantity of metal can be treated nearly as rapidly as a small one. The present practice is to provide an engine large enough to take in from 1000 to 1200 cubic feet of air per minute per ton of iron intended to be treated, the pressure to which it is condensed before delivery being governed by the height of the metal in the converter above the orifices of the tuyeres, and varying from 12 to 25 pounds per square inch.

The pneumatic or Bessemer process, thus briefly described, is one of the simplest, perhaps the very simplest, in metallurgy. For, although the apparatus required for its successful conduct is somewhat complex, it is so combined and arranged that the management of it by the party superintending conversions is not at all difficult, and the skill and experience needed to enable a manager to produce with ease and certainty products suited to all ordinary uses may be acquired in not to exceed one-fourth of the time which would have to be spent in learning to puddle iron well.

The plant, or the apparatus and fixtures for manufacturing under this process, consists of a blowing engine for compressing air and forcing it through the molten metal, reverberatory or cupola furnaces for melting the pig iron (when it is not taken directly from the blast furnace), small reverberatory furnaces for melting the spiegeleisen, franklinite or other carburizing and purifying materials, converting vessels into which the pig metal is run for being decarburized by the blast (two vessels being generally employed so that one may be in order while the other is under repair), ladles for conveying the steel to the molds, cranes for

handling the ladles and contents, and for lifting and handling the ingot molds, ingots, etc., hydraulic, steam, or other apparatus for working the cranes, and tipping the converters for receiving and discharging the metal, ovens for drying the linings of the ladles and the movable bottoms of the converters, ingot molds in number and character suited to the business to be done, and a variety of small appliances and tools for use in keeping in order the converters, ladles, etc.

The magnitude, and, to some extent, the details, of the "plant" for this process, will, of course, be governed by the amount of business to be done, and the size and character of the ingots or castings of steel or iron it is desired to produce, though there is in this business a greater uniformity of plan as to the machinery and appliances employed than in most other modes of making or working iron or steel.

The size of the converting vessels determines the character of the rest of the "plant," and those now in use vary from one to ten tons capacity each, the larger being, as a general rule, more economical proportionally to their product than the small ones. It must, however, be understood that large converters cannot well be used for treating small quantities of iron; for, as the interior of each vessel must be so planned and constructed that the iron intended to be worked in it shall have the least possible surface in proportion to its bulk exposed to the lining of the vessel, it will be desirable, in order that the least waste of metal and the best results shall accrue from the conversions, that each converter shall be worked at as nearly as possible its intended capacity.

What will in any case be the most desirable size of converter must be decided by facts and circumstances peculiar to it, though in this, as in most matters, there is a happy medium, which has been fixed at vessels of from five to seven tons capacity each, and the plant based upon the use of this size of converters has now been rendered exceedingly perfect in its details, and very easily managed.

Converters of from two to three tons capacity can, nevertheless, be economically worked, and in some sections of the country these may, perhaps, be employed to the best advantage.

The blowing engine is the most important as well as the most expensive portion of the apparatus. It must be large enough to treat the greatest quantity of iron it is intended to convert at one operation, and it is now commonly made of sufficient power to blow two or even more charges at once, so that large ingots may be cast if required.

The apparatus generally employed for blowing five-ton vessels consists of a pair of horizontal, direct-acting engines, with steam cylinders of 36 to 40 inches, and air cylinders of 54 to 60 inches diameter, both 5-foot stroke. These engines are coupled, and are worked with 50 lbs. of steam, at twenty to twenty-five revolutions per minute when a single conversion is being made, but they can be driven so as to convert charges in two or more vessels at the same time.

Keeping in mind the fact, previously stated, that successful working requires machinery capable of taking in air at atmospheric pressure at the rate of from 1000 to 1200 cubic feet per minute per ton of iron to be treated, and of condensing this air to and forcing it into the metal in the converter at a pressure of say 25 lbs. to the square inch above the atmospheric pressure, it will be easy to calculate the size and power of the blowing engine required for converting any given quantity of iron at one operation.

The cranes and the apparatus for tipping the converters, which are generally employed in the pneumatic or Bessemer plant, are operated by hydraulic power, communicated by a suitable force pump working at a pressure of from 300 to 400 lbs. per square inch; and the regularity and certainty of the action of the hydraulic machinery render it not only very convenient, but probably the cheapest in the end.

Steam is, however, in some establishments, applied directly for working the cranes and converters, and in a few of the earlier plants of a cheap and limited character, the cranes and converters were worked by hand. But the latter plan was too slow and uncertain in its operations to give economical results.

The cost of the various plants used in this manufacture will vary with the extent and perfection of the details; but the more complete these details, the less will be the labor required in proportion to the product made, and the smaller, also, will be the proportion of waste in working, and the liability to imperfect work.

As to the relative costs of works for making iron and Bessemer steel respectively, it may be stated that, assuming the ingots of steel to be in the same position as to finished product as puddled bars or charcoal blooms, an establishment to produce one hundred tons of Bessemer steel per day will cost but little, if any, more than one for making the same quantity of puddled bars or blooms.

Works for making small products of iron can be erected more cheaply than those for making small products of Bessemer steel, as the Bessemer process favors large production.

Several American works have turned out for weeks at a time 150 tons of ingots per day of 24 hours, and in the main the pneumatic or Bessemer process is more manageable, and requires less skilled labor, than the common processes of manufacturing iron.

From the foregoing statements it will be seen that manufacturing under the pneumatic or Bessemer process will, under any circumstances, involve a considerable outlay of capital for machinery and appliances, and that the process is especially adapted to large operations. And in most cases where the proposed production will not keep at least a two-ton plant regularly at work, it will be found cheaper for managers of forges and rolling mills to buy their ingots from large makers than to erect works and make for themselves. But when ingots are required

of such peculiar forms or qualities that they cannot easily be obtained of the large producers, and where power is very cheaply obtained and applied, or other circumstances operate to counterbalance their disadvantages, works on a small scale or larger ones to be worked only at intervals may be profitably established.

Theoretically, it should be the cheapest plan of working to convert the crude iron as it is tapped out of the blast furnace, and thus save the cost and waste of remelting; but, in this country, at least, very few furnaces or groups of furnaces, which produce a neutral iron, are large enough to keep a good sized plant regularly at work at its full capacity, and there are certain inconveniences in thus operating with furnaces, as ordinarily constructed and located, which more than counterbalance the saving of fuel, &c., which can be effected thereby.

The practical value and peculiar characteristics of the pneumatic or Bessemer metal are best shown in the great variety of applications which have already been made of it to uses requiring the best material obtainable. But in order to give the clearest idea that we can of the qualities of this product, as well as, at the same time, to answer the most common questions asked concerning it, we will consider the steel with reference to the following leading peculiarities of the metals with which it has to compete.

From the nature of the process (the impurities in the iron treated being thoroughly oxidized by the streams of air, and expelled as gases, or thrown off as slag, by the violent eruptions produced by the chemical and mechanical action of the blast on the charge), the product, as left from the conversion, is purer than similar metal refined by any other method.

The pneumatic or Bessemer metal, being maintained in a fluid state throughout its conversion from the pig iron, is cast at once into perfectly sound and homogeneous ingots or masses of any desired size; whereas wrought iron, whether made by the bloomery or puddling processes, being only an aggregation of the granules of metal which are developed in said processes, cannot be produced thereby in large masses, but the comparatively small and imperfect blooms or bars so produced must afterward be welded together for forgings of even moderate size; a treatment, which even under the most favorable circumstances, and with the best skill and care, fails to give perfectly sound and homogeneous products.

Fibre is never shown by this metal in any stage of its manufacture. Indeed, a pure metal cannot be fibrous; and the old dogma that fibre is a necessary concomitant of strength and toughness has long ago been shown to be an error. The absence of this quality from this metal renders it peculiarly fit for the manufacture of products which are pressed or struck up in dies for being cut into nails, tacks, &c., and for enduring punching, flanging and forging.

Its hardness, as has been already stated, may be of all the various degrees between a thoroughly decarburized, soft and weldable iron and a well carburized steel; but this metal never, while untempered, manifests the peculiar brittle hardness of the high grades of crucible steel. It is compact, firm and uniform, possessing, when most fully carburized, enough of the hardness of the ordinary cast steel to meet many of the practical needs in that respect, and yet with other qualities which render it applicable where a metal simply hard would not answer. Rails made from this product have already been proven to be more than twenty times as durable as the best quality of iron rails, and tires of the same material last very much longer than the most celebrated makes of iron tires. This steel has also been largely applied, and its use is rapidly increasing, for piston rods, shafting, spindles and other articles which encounter considerable wear.

Toughness is one of the most prominent characteristics of this product, and no iron or steel made by other modes can be compared with it in this respect. It is this quality, combined with its moderate hardness, great strength and stiffness, which makes the pneumatic or Bessemer steel so suitable for rails, axles, tires, flues and fire box sheets, and other articles used for and upon railroads. Indeed, so eminently superior has it been found to be in these respects to the best iron, that it is now very largely used both here and in Europe for the details of locomotive engines for which wrought iron was formerly employed; and it is well known that scarcely anywhere can the strength and toughness of metal be more severely tried than in the details of locomotives. A rail made of this steel was taken up one cold morning in 1862 from the line of an English railway, and a piece of it, while yet frosty, was put under a steam hammer and bent double without showing any sign of cracking. This rail was of the ordinary English double-headed pattern, weighing about 80 lbs. to the yard; and numbers of pieces of the same style of rails have from time to time, and in different localities, been similarly treated at milder temperatures, without the slightest rupture taking place. The above test not only shows the toughness of this steel, but it proves that the idea entertained by many persons that exposure to a low temperature will cause the metal to become brittle is unfounded. In fact, it has already been well settled, by experience on Russian and Canadian railways, that mild tempered steel, such as is generally used for axles and tires, is not so liable to be altered in its molecular arrangement by frost, or by the peculiar jarring wear encountered on railways, as are the best brands of fibrous iron, and the breakages of steel rails in winter on railroads in these cold countries are vastly less frequent than of iron rails.

As a further evidence of the toughness of the metal, we will add that circular plates, two feet in diameter and of $\frac{3}{4}$ and $\frac{1}{2}$ inches in thickness respectively, have, while heated, been "struck up" by suitable machinery into vessels 10 inches in diameter and 10 inches deep, the vessels being sound and perfect throughout; that very thin sheets have been worked into vases and other vessels with irregular outlines by the process of spinning, by which pewter ware is made; while in Austria, metallic cases for cartridges, such as are used in most breech-loading fire arms, have been stamped or struck up from thin sheets of steel, made from the superior charcoal irons of that country by the pneumatic or Bessemer process.

The fitness of the metal thus made for all intricate and difficult flanging in boiler work is now well known, and evidence might be adduced to almost any extent to show the extraordinary toughness of this new product.

The strength and tenacity of the pneumatic or Bessemer metal varies of course with its character. The metal is strongest in the most highly carburized condition in which it is malleable, and its strength decreases gradually and regularly as the percentage of carbon contained in it is lessened. Tests of this product made at the Woolwich Arsenal, in England, gave the unhammered ingots a range of tenacity from 41,242 lbs. per square inch for the average of the iron, to 60,031 lbs. for the average of the steel ingots tested. While tests of the hammered and rolled products gave an average of 72,643 lbs. as the strength of the soft iron, and 153,677 lbs. as the strength of the hard steel bars per square inch of section* and any grade of metal between these limits may be produced by this process.

Its great tenacity, coupled with its much greater elasticity than is possessed by the best iron, renders this product eminently valuable for plates for boilers, and for wrought beams, for tension rods, for girders, tie and suspension rods for buildings and bridges, and for all uses requiring the greatest possible strength in proportion to the weight of metal used. And it is also very desirable, and is largely used, for making wire for wire ropes and rigging.

The ductility and malleability of this product are, like its toughness, very great; and combined with its toughness and tenacity they render the metal superior to all others for crooked and difficult forgings, &c., &c. The following method of making steel tires, now regularly and extensively practiced at the celebrated works of the London and North Western Railway Company, at Crewe, and (slightly varied) by other makers, illustrates most clearly the remarkable excellence of the pneumatic or Bessemer steel, arising from the combination of its aforementioned qualities of ductility, toughness and tenacity:

For each tire of 5 feet diameter a conical ingot is cast, 22 inches high, 22 inches in diameter at the base, and only 6 inches at the top, being cast in this form so that any imperfect metal at the top of the casting shall be confined to a small area. As soon as the ingot is "set," or after it has been heated, if it requires so to be, it is forged and condensed under a suitable hammer into a disc, 22 inches in diameter and 9 inches thick, and is then reheated and placed under a conical punch, 17 inches long, 12 inches in diameter at its largest part, and tapering thence nearly to a point which is attached to the hammer block of a five-ton steam hammer, and by which a hole, 11 inches in diameter, is punched and worked through the ingot or disc, developing it into a hoop, 31 inches in external diameter and $5\frac{1}{2}$ inches thick. This hoop, having been again reheated, is then forged upon a beak iron projecting from an anvil face, which is inclined 30° from the vertical, until it has been enlarged to 34 inches external and 19 inches internal diameter, and at the same time a partial development of the flange of a tire has been made upon its rim, when it is once more and finally heated, and placed on a suitably constructed tire mill, where it is rolled at one operation into a finished tire 5 feet in diameter. Thus, in four heats only, a conical mass of steel, 22 inches in diameter and 22 inches high, is hammered, punched and rolled into a perfectly sound hoop or tire, 5 feet in diameter, with a section averaging about $5\frac{1}{2}$ by 2 inches; a treatment that is more than doubtful if any other iron or steel would endure. To show the quality of these tires, one of the blooms which appeared slightly defective was finished in the usual way, and afterward, while red hot, was placed upon a cast iron cylinder which it just fitted, and suddenly cooled. On being removed it was found that, although in cooling the tire had stretched $\frac{3}{4}$ of an inch, it had not cracked in the least under the ordeal.

In this connection, and as an evidence of the rapidity with which production can be carried on by aid of this process, the following feat in tire making may be interesting. The steel for six tires was on one occasion cast at Crewe at 6 h. 5 m. a. m., the first tire from it finished at 10 15, and the sixth at 11 17 a. m.—five hours and twelve minutes from the time the ingots were cast, or only a little more than seven hours from the time the pig iron from which they were made was charged in the melting furnace.

The pneumatic or Bessemer product may be subjected to any mode of treatment or working to which malleable iron or steel made by other methods is commonly exposed, as it can be made to possess all the good qualities of both of those metals without having the imperfections of either.

The heating of this metal must be carefully conducted, although, after an ingot has been clogged or rolled down one stage, it will safely bear any degree of heat required to work it well. When first heated the ingots should be brought slowly up to a barely bright red heat, and when first hammered or rolled they should be worked carefully. But after this they will bear a much higher heat, and may be hammered or rolled by

* These results have been repeatedly corroborated by experiments in this country.

machinery of adequate strength, with as great facility as iron ordinarily is.

This metal does not require to be hammered prior to being rolled, as both here and in Europe ingots are now regularly rolled directly into nearly all classes of products which are usually finished between rolls.

The welding of this metal either to itself or to ordinary iron can, even when the metal is well carburized, be effected readily with reasonable care on the part of the workmen. Piles of crop-ends of steel rails have been welded and drawn down into new rails with but little trouble, while steel headed rails, made by putting a thick bar of this steel on the top of a common iron rail pile, and welding and rolling the same, have been largely used abroad.

In view of the apprehended difficulty of welding this steel, considerable anxiety has been expressed by parties inquiring about the new manufacture, as to what can be done with the crop ends and scrap produced in the working up of the steel ingots. But, apart from the fact that, as before stated, the steel can be welded, we do not think this problem a difficult one to be solved.

In the first place, it must be borne in mind, that from the superior quality of the pig iron from which alone this product can be made, and despite the facts that with the different peculiarities of even first-class irons, and the variations in working them which will be likely to occur, there may be quite a difference in quality between the metal of any given class made at different times, and even between the same kinds of metal made at different times in the same works, this product will always be as good as the very best iron, and will be much more uniform in its various grades, no matter where or by whom produced, than the best makes of iron ever have been or can be. So that when once experience has settled the particular degree of hardness or carburization which will best fit this metal for any given use, the crop ends and large scrap made in the manufacture of articles for such use will always, wherever made, have very much the same qualities, and will be fit for rolling at once into various kinds of product now made from iron or steel produced in the ordinary ways. There will then be a demand for axle scrap for one set of uses, for rail scrap for another, for boiler plate scrap for another, and so on, till we may expect soon to see the time in the progress of this manufacture when parties now puddling iron for bolt, nut, washer, rivet, spike, band, hoop, plate and horseshoe iron, and for other miscellaneous uses in which much welding is not required, will be glad to stop their puddling furnaces, and buy the scrap and crop ends of axles, rails, boiler plates, etc., from the large manufactories working this metal.

A large quantity of this scrap is already used in Europe for the manufacture, by remelting, of tool steel, and the product so made is very fine. It may also be very advantageously mixed and melted with pig metal in the cupola or reverberatory furnace, when very tough castings are required, and much of it is thus used abroad.

Of course the worn-out steel rails can also be used as above; but as it has been pretty well demonstrated, in view of the average durability of iron rails on the greatest portion of the existing rail tracks of the country, and the known relative durability of steel and iron rails, that steel rails, if used very generally, would wear on the average more than fifty years, the problem what to do with them when worn out may safely be left for the next generation.

The articles now most generally made from the metal produced by the pneumatic or Bessemer process are rails, of which more than 600,000 tons are now annually rolled in Europe and in this country, axles, tires, boiler and ship plates, anchors, shafting, beams, girders, gun and rifle barrels, forgings for locomotives, stationary and marine engines, and for machinery of all kinds, and a great variety of other products which require to be made of first class material.

The use of railway axles, tires, boiler plates, and forgings of all kinds made of this steel is being very rapidly extended, and it is rapidly superseding iron for the axles and wheels of our carriages and wagons, the shoes of our horses, oxen and mules, the ploughs and harrows, spades, hoes and rakes of our farmers, the crow and prize-bars and mattocks of the laborers, the hammers, sledges and picks of the miners, the bolts and nuts for our machinery and agricultural implements, the nails and screws for our buildings and furniture, and numberless other small articles which have usually been made of iron.—Bulletin of Iron and Steel Association.

Formerly it was customary for the trades using sand paper constantly to make it for themselves as they needed it, out of ordinary brown paper, glue, and sand, as is done even yet in some parts of Europe. This business is now thoroughly organized in the United States. The paper is made of old rope, the best quality of glue is used, and, instead of sand, pulverized quartz or flint. By this means a superior article is produced, of a constantly uniform grade, at so low a price that the demand for it has become universal, large quantities being exported to Europe, South America, the Pacific Islands, and elsewhere. The amount made in the United States is very large, amounting to about 200,000 reams yearly, requiring a capital of at least 500,000 dollars. For every paper and every cloth a large demand has been created by the finished iron work in the steam engine shop, the sewing machine factories, and other similar industries which require them for polishing purposes.

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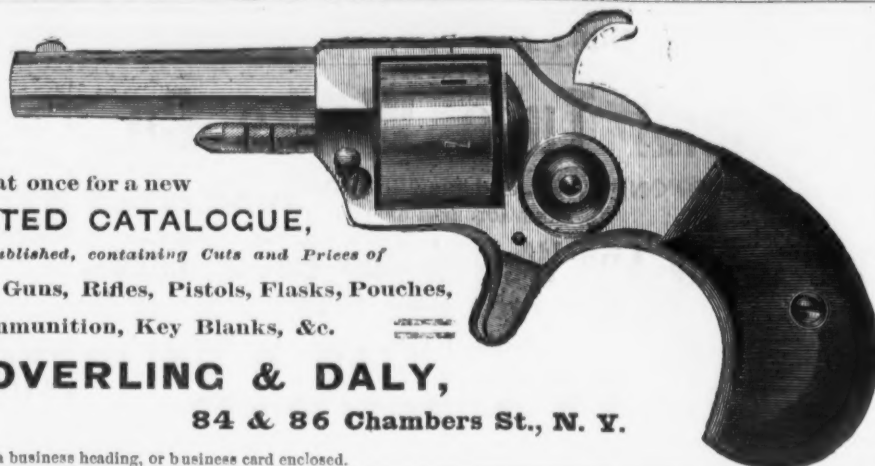
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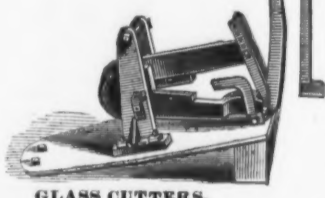
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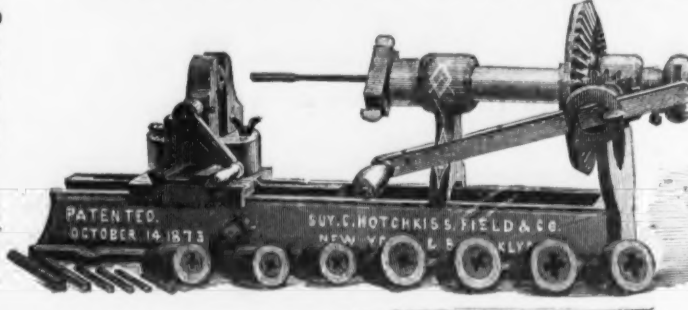
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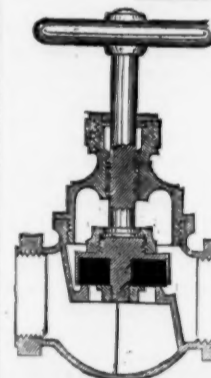
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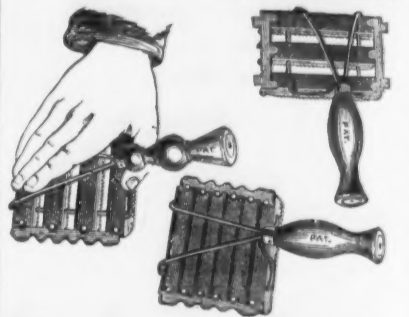
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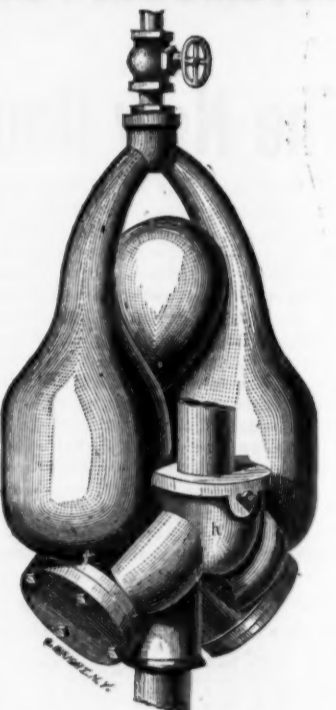
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Stearns G. N., Syracuse, N. Y. 1

Axles, Springs, etc., Manufacturers of.
Clark, Smith & Co., Fort Plain, N. Y. 12
Hotchkiss Guy C. & Field, Albany, E. D. 31
J. Palmer & Co., Concord, N. Y. 12
Wentworth & Co., Gardiner, Me. 12

Band Saws.
Ward & Co., Newburgh, N. Y. 12

Band Saws and Tools for Brazing &c., Importers of.
Gneault George & Son, 99 W. 4th, N. Y. 10

Bar Door Hangers.
Rider, Wooster & Co., Walden, N. Y. 23

Base Knobs.
D. E. Peck Mfg. Co., Bristol, Ct. 3

Bellows, Manufacturers of.
Churchyard, Joseph, Buffalo, N. Y. 3
Newcomb Bros., 386 Water, N. Y. 3

Belting, Leather.
Alexander Beck, 40 N. 3d, Phila. 1
Bradford & Sharp, Cincinnati, O. 8
Page Belting Co., 24 Exchange St., Boston. 8

Best Cages, Makers of.
Lindeman O. & Co., 264 Pearl, N. Y. 1
Maxheimer John, 269 Pearl, N. Y. 1

Best Braces, Manufacturers of.
Backus Q. B., Winchendon, Mass. 23
Bartholomew G. W. & H. S., Bristol, Ct. 1
Miller's Fall Mfg. Co., 73 Beekman, N. Y. 21

Bollers, Steam.
Tanner Wm. E. & Co., Richmond, Va. 16

Bolt Heading Machines, Manufacturers of.
Chapin Machine Co., New Hartford, Conn. 3
Pinno, Burdett & Barnard, Buffalo, N. Y. 3

Bolt Machinery.
American Bolt Co., Lowell, Mass. 11

Bone Manufacturers of.
Ansota Brass and Copper Co., 19 Cliff, N. Y. 1
Benedict & Barnham Mfg. Co., Waterbury, Conn. 1
Brooklyn Brass & Copper Co., 100 John, N. Y. 1
David John & Sons, 100 John, N. Y. 1
Manhattan Brass Co., 83 Reade, N. Y. 1
Plume & Atwood Mfr. Co., 80 Chambers, N. Y. 1
Seavill Mfg. Co., 4 Beekman, N. Y. 1
Smith & Co., 73 Beekman, N. Y. 1

Brick Presses, Makers of.
Carnell Geo., 1819 Germantown Ave., Phila. 2
Carnell F. L. & R. L., 1844 Germantown Ave., Phila. 2

Bridge Builders.
American Bridge and Roof Co., 5 Der, N. Y. 1
Butcher and Shoe Knives, Manufacturers of.
Wilson John, Sheffield, England. 2

Burr Stone Flouring and Grist Mills.
Leonard & Stillman, Bridgeport, Ct. 1

Butts and Hinges.
American Butte Co., Providence, R. I. 1
American Spiral Spring Co., 27 Park Row, N. Y. 1
Crooke & Co., 16 E. 1st, N. Y. 1
Fleming & Co., 16 E. 1st, N. Y. 1
Stanley Works, 99 Chambers, N. Y. 2
Union Mfg. Co., 99 Chambers, N. Y. 2

Cabinet Hardware.
Carnell Geo., 1819 Germantown Ave., Phila. 2
Carnell F. L. & R. L., 1844 Germantown Ave., Phila. 2

Carriage Bolts, Makers of.
Townsend, Wilson & Hubbard, Phila. 1

Carriage Hardware, Makers of.
Smith & Co., 73 Beekman, N. Y. 1

Car Wheels, etc., Manufacturers of.
Jackson & Woodin Mfg. Co., Berwick, Pa. 1
Taylor Iron Works, High Bridge, N. J. 1

Chains, Makers of.
Conck & Sons, Trenton, N. J. 1
Wright Thos. T. Eddy, Providence, R. I. 1

Chisels, Manufacturers of.
Baron D. & Co., 100 John, N. Y. 1
Bruck Bros., Milbury, Mass. 1

Coal, Miners of.
Pardee A. & Co., 111 Broadway, N. Y. 1

Coal Vases.
Jewett John C. & Sons, Buffalo, N. Y. 1

Coal Hods, Manufacturers of.
Easterbrook Wm., 81 Cherry, Phila. 1
Smith, Burns & Co., 43 Cliff, N. Y. 1

Coffee and Spice Mills.
Leitch Brothers, New York, N. Y. 1
Enterprise Mfg. Co., Philadelphia, Pa. 1

Commission Merchants, English.
Godard Samuel A. & Co., Birmingham, Eng. 1

Coppers, Tools, etc., Dealers in.
Little Chas. E., 39 Fulton, N. Y. 1
Sears & Co., 39 Fulton, N. Y. 1

Crabblers, Manufacturers of.
Newkumet Adam, 1837 N. Front, Phila. 1
Stow, Wile & Co., 100 Market, Phila. 1
Sears & Co., 39 Fulton, N. Y. 1

Curry Combs, Manufacturers of.
Bartholomew G. W. & H. S., Bristol, Ct. 1
Kellogg W. F. & Co., Troy, N. Y. 1
Wilson Hawksworth, Ellison & Co., 30 John, N. Y. 1
Wood Thomas & Chambers, N. Y. 1

Cutlery, Importers of.
Boker Hermann & Co., 101 Duane, N. Y. 1
Dietrich Wm. A., 50 Nassau, N. Y. 1
Fisher Jos. A., 41 Commerce, Phila. 1
King B. J. W., 41 Chambers, N. Y. 1
Sears & Co., 39 Fulton, N. Y. 1
Peters Bros., 48 Chambers, N. Y. 1
Ward Asine, 10 Duane, N. Y. 1
Wilson Hawksworth, Ellison & Co., 30 John, N. Y. 1
Wood Thomas & Chambers, N. Y. 1

Cutlery, Manufacturers of.
American Knife Co., Thomaston, Conn. 1
Burroughs Aaron, Peppercorn, Phila. 1
Merriden Cutlery Co., 49 Chambers, N. Y. 1
Miller Bros. Cutlery Co., W. Merriden, Conn. 1
Sears & Co., 39 Fulton, N. Y. 1
New York Knife Co., Walden, N. Y. 1
Woods Cutlery Co., Antrim, N. H. 1

Differential Pulley Blocks, Makers of.
W. H. Ward, New York, N. Y. 1

Door and Gate Springs.
The Challenge Door Spring Co., 49 Ann, N. Y. 1
Van Wagner & Williams, 2 Park Row, N. Y. 1

Dredging, and Makers of Dredging Machines.
Am. Dredging Co., 214 E. 16th Ave., Phila. 1

Drill Chucks, Manufacturers of.
Rull F. A. & Co., Danbury, Conn. 1
Rull F. A. & Co., Danbury, Conn. 1

Drilling Machines, Makers of.
Miller Falls Co., 73 Beekman, N. Y. 1
Thorne & DeHaven, Philadelphia. 1

Drop Forgings.
Hess & Co., 120 E. 16th Ave., Phila. 1
James Moore, cor. 13th and Buttowwood, Phila. 1

Edge Tools, Makers of.
Bradley G. W. 87 Chambers, N. Y. 1

Elevators.
Howard Geo. C., 178 18th, Phila. 1
Ous Bros. & Co., 316 Broadway, N. Y. 1

Emery.
Emery & Co., 12 Union Stone Co., 16 Exchange, Boston. 1
Emery Cloth.
The Union Stone Co., 16 Exchange, Boston. 1

Emery Wheels, Makers of.
Lehigh Emery Wheel Co., Mauch Chunk, Pa. 1
Tantite Company, Stroudsburg, Pa. 1
The Union Stone Co., 16 Exchange, Boston. 1

Engineers, Machinery, etc.
Hess & Co., 120 E. 16th Ave., Phila. 1
James Moore, cor. 13th and Buttowwood, Phila. 1

Engines, Steam, Makers of.
Haskins' Machine Co., Fitchburg, Mass. 1
Hess & Co., 120 E. 16th Ave., Phila. 1
Shapley & Wells, Birmingham, N. Y. 1
Tanner Wm. E. & Co., Richmond, Va. 1
Wentworth Works, Hartford, Conn. 1

Exporters.
Kontell & Esler, 116 Fulton, N. Y. 56

Faucets, Self-Measuring, Makers of.
Emery & Co., 12 Union Stone Co., 16 Exchange, Boston. 1

Files, Importers of.
Larr J. & Riley 82 John, N. Y. 1
Lindeman Henry, 66 and 68 Reade, N. Y. 1
Pinefield Bros., 100 John, N. Y. 1
Fraser Peter A. & Co., 36 Fulton, N. Y. 1
Sanderson & Co., 100 John, N. Y. 1
Spear & Jackson, 36 Chambers, N. Y. 1

Fire Brick, Makers of.
Amford Bldg. Co., Patchett, R. I.
Auburn Fire Works, Auburn, R. I.
Barnett C. & H., 41 and 43 Richmond, Pa.
McCafee & Bro., 1732 and 1734 N. 4th, Phila.
Nicholson Fire Co., Providence, R. I.
Greiner, Clingan & Co., Middletown, N. Y.
Hart & Plattsburgh, 33 Chambers, N. Y.
Western Fire Works, Beaver Falls, Pa.

Fire Brick, Makers of.
Dyke, St., Brooklyn, N. Y.
Hall & A. Sons, Perth Amboy, N. J.
Hart & Plattsburgh, 33 Chambers, N. Y.
Kreischer R. & Son, 18 Goerck, N. Y.
Newkumet Philip, 2nd and Vine, Phila.
Rosenfeld & Co., 100 Broadway, N. Y.
Salamander Works of Woodbridge, N. J. foot of
Bethune St., N. Y.
W. W. Hall, Perth Amboy, N. J.

Fluting Machines.
Felder Chas., 105 Beade N. Y.
Meyers Mfg. Co., 300 Centre, N. Y.

Flint and Emery Paper and Cloth.
Wagner Adamson & Co., 73 Market, Phila.

Galvanized Iron.
Lefferts Marshall Jr., 90 Beekman, N. Y.
N. S. Greenleaf, 1 L. L. N. Y.

Giant Nail Works.
Malby, Curtis & Co., Westbury, Ct.

Glass, Importers of.
Downing A. C. & Co., 51 Beekman, N. Y.

Grocers.
Shive Governor Co., Bethlehem, Pa.

Grindstones.
Wood Walter R., 283 and 283 Front, N. Y.

Guns &c.
Schuyler & Daly, 94 Chamber St.
Tryon Edw. K. Jr., 18 N. 9th, Philadelphia.
Windmuller Louis & Roelker, 30 Beade N. Y.

Gunpowder, Makers of.
Burdette J. L. J., 70 Wall, N. Y.
Lafin & Hand Powder Co., 31 Park Row, N. Y.

Hammers, etc., Manufacturers of.
Hart Hammer Co., Brooklyn, E. D. N. Y.

Hardware.
Tiebout W. & J., 280 Pearl, N. Y.

Hardware Commission Merchants.
Fernald & Sise, 101 Chambers, N. Y.
Leaves N. N. & Co., 101 Chambers, N. Y.
Graham & Haines, 85 Chambers, N. Y.
Malby, Curtis & Co., 64 Beade, N. Y.
Merritt & Co., 101 Chambers, N. Y.
Walsh, Coulter & Flagler, 53 Chambers, N. Y.

Hardware Dealers.
Love, Supple & Walton, 65 Market, Phila.
Quisenberry, Townsend & Co., 59 Beade, N. Y.
Shepard Sidney & Co., Buffalo, N. Y.
Turner, Schurmer & Judin, 41 Duane, N. Y.

Hardware Manufacturers.
Beam & Murphy, 93 Chambers, N. Y.
Boker Hermann & Co., 101 Duane, N. Y.
Field Alfred & Co., 101 Chambers, N. Y.
King H. & J. W., 30 Chambers, N. Y.
E. Frith, 16 Cliff, N. Y.
Turner W. & M. & Co., 101 Chambers, N. Y.
Turner R. A., 57 Chambers, N. Y.
Windmuller Louis & Roelker, 30 Beade N. Y.

Hardware Manufacturers.
Biddle Mfg. Co., 101 Chambers, N. Y.
Buffalo Hardware Co., Buffalo, N. Y.
Enterprise Mfg. Co., Phila.
Hart & Plattsburgh, 33 Chambers, N. Y.
Jacobus & Nilmick Mfg. Co., 59 Chambers, N. Y.
Kellings Wm. F. & Co., Troy, N. Y.
Lancaster Co., 101 Chambers, N. Y.
Many & Marshall, 45 Warren, N. Y.
Middletown Tool Co., 82 Chambers, N. Y.
Merritt & Co., 101 Chambers, N. Y.
Pratt & Co., Buffalo, N. Y.
Schwulitzer Mfg. Co., 37 Beade, N. Y.
Stanley Tools, 79 Chambers, N. Y.
The Wetherill Novelty Co., Wetherill, Ct.
Wright & Seymour, 101 Chambers, N. Y.
Union Mfg. Co., 50 Chambers, N. Y.
Williams, White & Churchill, 13 Warren, N. Y.
Winning Co., 37 Chambers, N. Y.

Hardware Specialties.
Bryington & Northup, Rochelle, Ill.
Mars & Co., 138 Centre, N. Y.
Pett & C. C., 101 Chambers, N. Y.
Pugley & Chapman, 6 Gold, N. Y.
Shepard Sidney & Co., Buffalo, N. Y.
Wright & Russell, 101 Chambers, N. Y.

Holating Engines, Makers of.
Howard Geo. C., 17 S. 18th, Philadelphia.
Otis Bros. & Co., 348 Broadway, N. Y.
Wright & Russell, 101 Chambers, N. Y.

Horse Hay Forks and Fixtures, Makers of.
Nellis A. & Co., Pittsburgh, Pa.

Horse Nails, Makers of.
Burdette J. L. J., 70 Wall, N. Y.
Brundage & Co., Middletown, N. Y.
Globe Nail Co., Boston, Mass.
Merritt & Co., 101 Chambers, N. Y.
Putnam S. B. & Co., Neponset, Mass.

Horse Shoes, Makers of.
Burdett Iron Works, Troy, N. Y.

Home Furnishing Goods.
Hill & Howard, 15 Murray, N. Y.

Hosiers.
Parks Bros., Princeton, Ill.

Hydraulic Jacks.
Indegee & Richard, 24 Columbia, N. Y.

Insurance, Boiler.
Hartford Steam Boiler and Inspection Co.

Iron Brokers.
Boynton Geo. A., 70 Wall, N. Y.
Hazard & Jones, 281 Pearl, N. Y.
Read & Dickey, Cleveland, O.

Iron, Carriers of.
Hartford Steam Boiler and Inspection Co.
Mosely Iron Bridge and Roof Co., 8 Day, N. Y.

Iron, Charcoal, Warm or Cold Blast.
John Wm. J., 101 Chambers, N. Y.

Iron Commission Merchants.
Geo. D. Althouse, 31 Walnut, Philadelphia.
Bickston & Cox, 383 Walnut, Phila.
Cleveland, Brown & Co., 101 Chambers, N. Y.
Hend J. A. C. & Co., 614 and 616 Market, Phila.
Hoopes W. Graham, 419 Walnut, Phila.
Hudson & Co., 228 Erie, Phila.

Iron, Pig, Importers of.
Williamson James & Co., 69 Wall, N. Y.

Iron Dealers.
Abeel Brothers, 195 South, N. Y.
Borden & Lotford & Co., Youngstown, O.
Borden & Lovell, 70 and 71 West, N. Y.
Cleveland, Brown & Co., 101 Chambers, N. Y.
T. B. & Co., 11 Cliff, N. Y.
Conklin & Huerstel, 90 Market Slip, N. Y.
Faulkner & Co., 101 Chambers, N. Y.
Fraser, Dana & Flitz, 101 North, Boston.
Gardner Wm., 575 Grand, N. Y.
Hart G. A., 208 Walnut, Phila.
Hudson, Hopkins & Stokes, 104 John, N. Y.
Hudson & Co., 228 Erie, Phila.
John B. F., 457 and 459 Water, N. Y.
Matthews Chas. W., 138 Walnut, Phila.
Phillips Thos. & Co., Providence, R. I.
Packard, Goff & Co., Youngstown, O.
Petree & Mann, 225 and 229 South, N. Y.
Pier & Co., 101 Chambers, N. Y.
Pier & Co., 24 Broadway, N. Y.
Quincy John W., 56 William, N. Y.
R. W. V. & Co., 101 Chambers, N. Y.
Smith Gam'l G. & Co., 342 Pearl, N. Y.
Warner A. B. & Sons, 23 and 25 West, N. Y.
White Alfred R., 58 Hudson, N. Y.

Iron, Manufacturers of.
Britannia Iron Works, Middleboro', Eng.
Burdett Iron Works, Troy, N. Y.
Cleveland Rolling Mill Co., Cleveland, O.
Coffin Wm. E. & Co., 5 Oliver, Boston.
Cleveland, Brown & Co., 101 Chambers, N. Y.
Everson, Graf & Macrum, Pittsburgh, Pa.
Fukon S. & Co., 245 E. Third, Phila.
Leonard John, 455 and 457 West St., N. Y.
Milwaukee Iron Works, Milwaukee, Wis.
New Haven Rolling Mill Co., New Haven, Ct.
Old Dominion Iron Works, 101 Chambers, N. Y.
Phenix Iron Co., 419 Walnut, Phila.
Phenix Iron Co., 419 Walnut, Phila.

Iron, Swedish, Importers of.
Jesop Wm. & Sons, 91 and 93 John, N. Y.
Mittler Nils, 69 William, N. Y.

Lace Lenders.
Hartford Steam Boiler and Inspection Co.

Lamp, Manufacturers of.
Dietz R. E. (Tubular) 44 and 50 Fulton, N. Y.
Fulton & Morse, 5 Fulton, N. Y.

Lead Kettles.
Phillips Thos. & Co., Providence, R. I.

Locks, Manufacturers of.
Babnahan Wilson, Broadway and Kosuth, Brooklyn.
Brooklyn Lock Works, Brooklyn, Conn.
Sawick Lock Co., 101 Chambers, N. Y.
Trenton Lock Co., 44 Warren, N. Y.
Tale Lock Mfg. Co., Broadway, N. Y.

Machines, Makers of.
Bement Wm. B. & Son, Philadelphia.
Clague Machine Co., New Hartford, Conn.
Clague Machine Co., 121 Chambers, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Seligman & Co., 101 Chambers, N. Y.
Watson Andrew, 387 Dickinson, Phila.
Wetherill Robert & Co., Chester, Pa.
Wright & Russell, 101 Chambers, N. Y.

Machine Screws, Makers of.
American Screw Co., Providence, R. I.
Hart & Plattsburgh, 33 Chambers, N. Y.

Machine Tools, Makers of.
Blaisdell P. & Co., Worcester, Mass.
Brown & Co., 101 Chambers, N. Y.
Steel Tool Co., Providence, R. I.

Machinery and Tool., Importers of
Sturges & Co., 87 Chambers St., N.Y.
London, England.

Mathematical Instruments.
Dodge & Gear, 116 Fulton, N. Y.

Measuring Tools.
Eddy Geo. & Co., 363 Clason Ave., Brooklyn, N. Y.

Meat Cutters, Makers of
Biltemore D. H., Worcester, Mass.

New Dealers and Brokers,
Gordner W. B. & Corbin S. J. Cliff, N. Y.
Cott Edward W., 304 Walnut, Phila.
Crane C., 194 John, N. Y.
Grass L. E. Co., 230 and 232 Water, N. Y.
Grege H. L. Co., 123 Walnut, Phila.
Hawley R. G. & Son, South & 3d Pearl,
Phila.
Phipps Dodge & Co., 25 Chamber, N. Y.
Purves A. B. Son, cor. Beuth and Penn, Phila.
Rosenberg Geo. D., Potteryville, Pa.
Thompson & Co., 213 and 215 Water, N. Y.
Van Wart & McCoy, 43 Chambers, N. Y.

Nailfinishes.
Brown & Brett, 309 Walnut, Phila.
Drown Thomas M., 1228 Girard, Phila.
Maynard & Van Hasenelaer, 24 Cliff, N. Y.
School of Mine, E. 49th, N. Y.

Mining Spikes
Rosenberry Geo. D., Potteryville, Pa.

Molders' Tools.
Cartwright & Sons, 200 Pearl, N. Y.

Mouth Traps, Catchmentals, etc.
Mietz R. E., 54 and 56 Fulton, N. Y.

Nails Platers.
New York Nickel Plating Co., 138 West 25th, N. Y.

Norway Sawmills.
Rowland Wm. & Harvey, Garfield, Phila.

Note Broker.
Gallandier F. W., Sand 5 Wall, N. Y.

Oils, Belts, etc., Makers of
Armstrong & Co., 75 and 77 Prince, Lowell, Mass.
Arns Bell & Co., Youngstown, O.
Carpeniter David, 422 Yates, N. Y.
Clark & Co., 100 Nassau, New York City.
Fuller Lord & Co., Boonton, N. J.
Hall J. H. & Co., Pawtucket, R. I.
Old Colony Rubber Works, Boston, N. Y.
Rosenberry Geo. D., Potteryville, Pa.
Sullivan & Small & Ward, Fort Chester, N. Y.
Plumb, Burdell & Co., 2nd Street, N. Y.
Steinbergh J. H., Reading, Pa.
Taylor U. G., 38 Beckman, N. Y.

Oilers, Makers of
Austin J. & Co., 168 Fulton, N. Y.

Oil Iron, etc.
Gregg H. L. & Co., 106 Walnut, Philadelphia.

Pancreasches.
Blake Crusher Co., New Haven, Ct.

Paints.
Rocky Mountain Vermillion Paint Co., Prov., R. I.

Paints and Oils, Dealers in
Reverly P. W. & Co., 171 Fulton, N. Y.

Patent Solicitors.
Bronson A. V., 238 Broadway, N. Y.
Howison & Son, Phila. and Washington, D. C.

Plate Nails, etc., Manufacturers of.
Richards T. L. & Co., 47 Murray, N. Y.

Pipes, Fittings, etc., Makers of
Adams & Cole, 36 John, N. Y.
Bracewell & Hartin Mfg. Co., 100 Hudson, N. Y.
Nelson, Finkel & Co., 430 E. 10th st., N. Y.
Pancoat & Maule, 221 Park, Phila.
Payne & May Jr., 45 and 47 Gold, N. Y.

Pipe, Water and Gas, Makers of
Brick R. A. & Co., 112 Leonard, N. Y.
Graff William & Co., Pittsburgh, Pa.
McIntosh Joseph & Son, 125 Harrison, N. Y.
Morris Taiker & Co., 15 Gold, N. Y.
National Tube Works Co., 78 Williams, N. Y.
Woodward Foundry & Mach. Co., Phillipsburg, N. J.
Wren H. D. & Co., 173 Broadway, N. Y.

Pine Packing.
Canfield John & Co., 131 Fairmount Ave. Phila.

Plane Irons, Manufacturers of
Back Brock, Millbury, Mass.
Beck Charles & Co., Middletown, Conn.
Middletown Tool Co., Middletown, Conn.
Sandusky Tool Co., Sandusky, O.

Planing, Manufacturers of
Greenleaf's Son, Pine Meadow, Conn.
Greenfield Tool Co., Greenfield, Mass.
Ohio Tool Co., Columbus, O.
Roberts Rule & Level Co., 38 Chambers, N. Y.

Plated Ware.
Rogers & Bro., 20 Broadway.

Plumbing Lubricator.
Richard Lee & Co., 172 Forsyth, N. Y.

Plumbers' Materials, Manufacturers of
Carr Wm. S. & Co., 106 Centre, N. Y.

Portable and Stationary Forces.
Kellogg Wm. P. & Co., 121 Chambers, N. Y.
Kearney & Co., 112 Madison, Philadelphia.
Keuning H. S. & Co., 111 Liberty, N. Y.

Presses, Presses of.
Am. Saw Co., Trenton, N. J.
The Stillie & Parker Press Co., Middletown, Ct.

Pressure Flasks, Makers of
Stanley B. S., 75 Sudbury, Boston.

Pumps, Makers of
Burlingham & Purdy, 108 Chambers St.
Douglas W. & B., Middletown, Conn.
Union Mfg. Co., 90 Chambers, N. Y.
Valley Mob. Co., Easthampton, Mass.

Pyrometers.
Brown Edward, 511 Walnut, Phila.

Railroad and Miners' Tools.
Hogan, Clark & Sleeper, Boston.

Railroad Supplies.
Booth Hoffman & Co., 110 Liberty, N. Y.

Rails, Importers of
Congreve Chas. & Son, 104 and 106 John, N. Y.

Rails, Iron or Steel, Makers of
Atkins Bros., Footbridge, London.
McCubria Iron Co., Johnston, N.H.
Cleveland Rolling Mill Co., Cleveland, O.
Crowlaid John & Co., Milwaukee, Wis.
Milwaukee Iron Co., Milwaukee, Wis.

Razor Straps, Makers of
B. F. Badger, Charlestown, Mass.

Rivers.
Holden River Tools, 116 Chambers, N. Y.
Tunmes Peter, 281 North 6th, Brooklyn, E. D.

Rolling Mill Machinery, etc., Manufacturers
Birmingham Iron Foundry, Birmingham, Ala.
Baltimore & Co., 110 Lexington wood, Phila.

Rolls, Chilled and Sand, Makers of.
Garrierson A. & Co., Pittsburg, Pa.

Rules, Manufacturers of
Charles's Son, Pins and Leadow, Ct.
Stanley Rule and Level Co., 38 Chambers St.

Saws, Makers of
Atkins E. C., Indianapolis, Ind.
American Saw Co., Trenton, N. J.
Boynton E. M., 60 Beckman, N. Y.
Brooks & Co., 100 Chambers, N. Y.
Diston Henry & Sons, Phila.
McNeelce Wm., 515 Cherry, Phila.
Pease Harvery W., Williamsburgh, N. Y.
Spicer & Jackson, 116 Duane, N. Y.
Thomas & Marston, 100 Middle town, N. Y.

Saw Frames, Wood, Makers of
Boynton E. M., 60 Beckman, N. Y.
Pearse Harvery W., Williamsburgh, N. Y.

Scenes, Manufacturers of
Hehle Bros., 9th Avenue, Phila.
Fredericks & Co., 113 Chambers, N. Y.

Screens, Makers of
American Screen Co., Providence, R. I.
Lambert & Co., 206 Querry, Phila.

Screw, Importers of
Bruce George W., 1st N. Y.
Guental George & Son, 39 W. 4th, N. Y.

Showels, etc.
Shannon Shorel Co., 31 Chambers, N. Y.
Clement & Hawkes Mfg. Co., Northington, Mass.
Winchboro Showet Co., 60 Oliver, Boston.

Skates.
Florence Sewing Machine Co., Florence, Mass.

Smelters Works.
Seaves Paul S., 760 Broad St. Phila.

Stamped and Jampaned Flat Wire.
Schneider Jos. & Co., 56 Beckman, N. Y.
Shepard & Co., 100 Chambers, N. Y.

Steam Hammer, etc., Makers of
Duighton Richards, 24 Columbia, N. Y.
Middletown Tool Co., Middletown, Conn.

Steel.
Changer John W., 96 William, N. Y.

Spikes, H. R. &c., Manufacturers of
Fahrign, G. W., Silles, Ohio.

Spring.
Rowland Wm. & Harvey, Frankford, Phila.

Squares, Steel and Iron, Makers of
Robertson & Hyatt, 200 Chambers, N. Y.

Steam Pipes, etc., Manufacturers of
Carl & Cortlandt, N. Y.
Gold & Garrison, Williamsborough, S. Y.
Philadelphia Hydraulic Works, Evansville, Ind.
Third street, No. 10, Liberty, N. Y.

Steam Traps.
Alonso L. Jones, 130 S. 4th, Phila.

The Molasses Best Castings Co., Evelina and Levan Streets, Philadelphia.
Cart J. & Riley, 35 John, N. Y.
Cocker Brook, Sheffield, Englad.

Tires, Makers of
Robinson Francis & Son, 97 John, N. Y.
Scott Wm. & Son, 21 and 99 John, N. Y.
Simons & Co., 24 Broadway, N. Y.
Snyder & Co., 100 Chambers, N. Y.
Stanton Geo. & Co., 57 John, N. Y.
Van wart & McCoy, 43 Chambers, N. Y.
Walker James, 100 Chambers, N. Y.
W. Hawkwater, Ellison & Co., 75 John, N. Y.

Steel Manufacturers.
 Anderson & Vose, Pittsburgh.
 Chrome Steel Co., Brooklyn, E. D.
 Cleveland Rolling Mill Co., Cleveland, O.
 Dwyer, D. G. & Co., Jersey City, N. J.
 Graveland John A. & Co., Troy, N. Y.
 Huesey, Wells & Co., Pittsburgh.
 Miller, Barr & Parsons, Pittsburgh.
 Retter, Sutton & Co., Pittsburgh, Pa.
 Reed, Gray & Woods, Pittsburgh.
 Rowland Wm., a Harvey, Frankford, Pa.
 Singer, Nimick & Co., Pittsburgh.

Stone Crushing Machines.
 Black Crusher Co., New Haven, Ct.

Stoves.
 Bardett, Smith & Co., Troy, N. Y.

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The Chemistry of Coal.

BY EDWARD J. HALLOCK, A. M.

Several thousand years before the creation of man, there existed in various parts of the world shallow inland seas and marshes. The water was not very cold and the air was warm and moist, so that the sea weeds and rushes of that day grew tall and luxuriant. Some suppose that the air also contained large quantities of carbonic acid, although plants of our day do not flourish in air too heavily charged with this gas, which is to vegetation the "vital air." Be this as it may, there doubtless existed great forests of plants, their roots growing in the mud under these fresh water seas, but the branches reaching far up into the warm sunshine. Many of these plants, of course, died, and, falling into the water at their feet, underwent a very slow decay, such as we see in peat bogs now-a-days. Successive generations piled one upon another, forming layers of considerable thickness. The oxygen and hydrogen, of which the wood is in part composed, were able to unite in the form of water, although a portion of the former, no doubt, consumed a portion of the carbon to form carbonic acid, while the latter combined with another portion of the carbon to form, as it does in swamps today, marsh gas. The possible changes that these three elements may undergo, when liberated in the presence of each other, are innumerable. For our purpose it is enough to know that most of the carbon remained behind, combined with more or less of these hydrocarbons and other bituminous matter. We can form but little idea how long this continued. At length, however, the waters rose, either from the gradual depression of the earth's surface at this point, or because of some change of barriers. The muddy streams flowing into this lake brought an accumulation of sand and clay, which entirely buried every trace of vegetation, but so gently was it sometimes deposited that it took very accurate impressions of the bark, leaves and fruit, that fell upon the surface of successive deposits of the mud. When another convulsion of the earth caused an elevation of this spot, and vegetation flourished a second time, another mass of vegetable debris accumulated, which was, in turn, buried in the mud by a second depression and inundation. In the course of time, these strata of clay were converted by heat and pressure into slates and shales. If the overflowing waters brought sand and gravel with them, the stone formed was sandstone or conglomerate. The mud beneath these ancient forests has also turned to stone, which often bears the name of millstone grit. Pressed for centuries between these two layers of stone, and acted upon by certain igneous and volcanic agencies, the woody portion of the plants loses part or all its volatile constituents and is converted into coal.

The coal plants consisted principally of a sort of ground pine, *Lepidodendron*, a jointed, rush-like plant of 30 feet high, called *Calamite*, various kinds of ferns, some of which had fronds 6 to 8 feet long, and, most abundant of all, the *Sigillaria*, which grew up a simple trunk to a height of 30 to 60 feet without branches, and terminated in a head of long, narrow leaves. About 350 species of coal plants have thus far been observed in the American coal fields. The animal life of that day included certain species of fishes, reptiles, insects, spiders and articulates.

True coals are divided into several classes, according to the amount of volatile matter contained in them. The richest bituminous coal contains 40 to 60 per cent. of volatile matter. It takes fire like a candle, burns readily, gives out much flame and smoke, and hence is called cannel coal. It is considered the best gas coal, and is found both in Scotland and in our Western coal fields. Common bituminous coal contains less volatile matter, and yields from 50 to 75 per cent. of fixed carbon; semi-bituminous coal from 75 to 90 per cent. of carbon; while anthracite yields upward of 90 per cent. of carbon. The amount of ash or mineral matter varies from 1 to 13 per cent.

Stone coal was mentioned by Theophrastus, B. C. 371, but little was known of it at that time. The coal fields of England were evidently worked by the ancient Britons before the Roman invasion, but the earliest record of its use there is A. D. 852. In 1612 an attempt was made to use it for making iron, but this was not successfully accomplished until a century later, in 1718. In America, the bituminous coals of Richmond, Va., were worked as early as 1750. The difference between anthracite and bituminous coal is so great that the early settlers of Pennsylvania naturally considered the former incombustible. It is stated that anthracite coal was first used by two blacksmiths named Gore, in 1768-9, but was not employed for domestic purposes until 1808, when Judge Fell succeeded in burning it in a wooden grate. The secret or mystery of burning anthracite was discovered by accident. Mr. White, of Philadelphia, who had made numerous persistent efforts to ignite the "black stones" by poking, raking, stirring and blowing upon them, at last gave up in despair, and, leaving his furnace filled with a mixture of wood and coal, went home to dinner. Fortunately, there were some sparks left upon the wood, and, more fortunate still, the furnace door was left closed, with the draft open. This arrangement afforded the necessary "let alone" treatment, and the wood, soon igniting, heated the coal to a point where it also could be ignited; and as the down-cast experimenter returned to rake out and throw away the supposed worthless coals, he found them, to his surprise, all aglow, and causing such an intense heat that his furnace was well nigh destroyed. This result, of course, dispelled the idea that anthracite was an incombustible substance, and soon companies were formed to work the mines.

Graphite, or plumbago, is believed to be anthracite coal which has been subjected to the

most extreme degree of mineralization or metamorphism, being frequently found in igneous rocks. It is often produced in blast furnaces, and is found in cast iron. It consists of almost pure carbon with a slight admixture of iron. It is infusible, insoluble and a conductor of electricity; it is used for crucibles, lead pencils, lubricators, and for several other purposes.

Brown coal comes from coal beds more recent than those of the carboniferous; it is generally of a brownish-black color, but often resembles ordinary bituminous coal. When the coal retains the form of the original wood it is called lignite. Jet is a black variety of brown coal, compact in texture and taking a good polish, whence its use in jewelry.

Bituminous coal sometimes contains iron pyrites; these are acted upon by moisture, and hence wet coal sometimes takes fire spontaneously. When any kind of rich bituminous coal is subjected to the action of heat, air being excluded, the volatile matter is driven off, forming our common street gas, and a large quantity of so-called "coal tar," ammonia and other products are produced. The residue, known as coke, is a spongy mass, similar to anthracite in composition, but ignites readily and burns up rapidly. Wood heated in close vessels also yields gas and tar, but the residue, called charcoal, preserves the original form and structure of the wood. It is so porous that it readily absorbs gases, which makes it useful as a disinfectant. It is also used for decolorizing liquids filtered through it, although animal charcoal, made by burning bones, is preferred to wood charcoal for this purpose.

The diamond has a composition so similar to coal and graphite that we must briefly allude to it here as being the purest form of carbon known. It has probably been produced, like mineral coal and oil, from the slow decomposition of vegetable or animal matter, under the effects of intense heat, as it is found only in the gold regions, where argillaceous and arenaceous schists have suffered metamorphism. Every form of carbon, whether diamond or coal, when burned with full access of air, produces carbonic acid, just as the particles of our bodies do when burned in the process of breathing. This heavy gas is irrespirable, as many persons have discovered when drinking soda water or seidlitz powders. It can scarcely be called a poison, for when taken into the stomach it does no harm. Unfortunately, this is not the only product of the combustion of coal. Coal often contains sulphur, which produces, when burning, sulphurous acid, a dangerous and disagreeable gas. Worse still than both of these is the carbonic oxide gas, produced when the coal is burning slowly, or when carbonic acid passes over red hot coals. It burns with a blue flame, which may often be observed playing over a coal fire when fresh coal has just been added. It is a little lighter than atmospheric air, and mixes readily with it. Carbonic oxide is such a violent poison that a few per cent. of it in the air of a room will produce death, while still smaller quantities cause headache and dizziness. In Paris this gas is the favorite instrument of suicide; the unhappy person obtains a brazier of burning charcoal, closes the doors and windows, and in a few minutes life is extinct. This deadly gas is the most useful of all gases to the metallurgist. Its affinity for oxygen enables it to take that element from ores and oxides, thus reducing them to the metallic state.

The sun, our great luminary, and source of an unlimited amount of heat, has, in reality, furnished us with all our sources of power. Artificial heat, as we call it, is only heat that was sent from the sun to the earth many centuries ago, and which has been carefully stored up in immense beds of coal, to be given out to-day in making our railroads and driving our engines. Not only heat, but the chemical force which shall reduce our iron ores, is stored up in our coal beds. The same coal beds furnish us with our means of illumination, and the light which fell upon the earth before man was created now illuminates our streets at night. Force, like matter, may assume different garbs and pass under different names; it is, like matter, indestructible.—*Journal of Applied Chemistry.*

Creeping Clay.

A peculiar kind of clay, says the Virginia *Enterprise*, is found in places in our mines, which is not a little curious on account of its creeping propensities. A stratum of this clay will crawl out into tunnels and other openings in a manner much resembling the action of the toy known as Pharaoh's serpents. You can't see where it is coming from or what moves it, yet it is constantly crawling out. In the drift which is being run into the American Flat mine, at a depth of 750 feet, they have a stratum of this clay. In order to keep the drift open, it is necessary to keep one man constantly engaged in cutting away the clay as it pushes itself into the drift. This is not owing to the slaking and swelling of the exposed surface, as in that case after a few removals of the surplus material a hole would be left. The whole body of clay appears to be creeping. It has the almost imperceptible motion of the glacier, and, like the glacier, irresistibly advances, smashing everything in the shape of timbers that may be placed in its way. The cause of this creeping is probably to be found in the pressure of the superincumbent or surrounding strata of rock. Its motion is not unlike that seen during the straightening out of a piece of pith which has been compressed. There appears to be a limit to this creeping of the clay, but it is not reached until many feet have crept out into the drift, tunnel, shaft or chamber, and been cut off and removed. Its action is so mysterious that some of the miners are ready to explain it by simply saying that it is because "nature abhors a vacuum." If left to its own course it would very soon close the drift, tunnel or other opening so completely that no one could see that an opening had ever been made in it; indeed,

thousands of feet of drifts and tunnels in our mines are now so closed. In the Caledonia mine much trouble was experienced with this creeping clay. We have heard of a streak of it two or three feet in width rising up in the floor of a tunnel until over thirty feet had come up and been cut off. It is bad anywhere, but is most mischievous in main shafts. For this reason mining men always seek a spot, in which to put down such shafts, where they are likely to have solid country rock (rock outside of the vein) to a great depth below the surface. The sad experience of early days taught them the lesson.

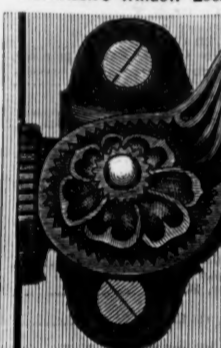
Captain Bjorkmann, of Stockholm, has compounded a new explosive substance, which he calls *vigorite*, possessing a greater power, as it appears, than any of the other similar substances, such as dynamite and libofractor. In this case, as in that of the substances just named, nitro-glycerine is the base of the matter which gives rise to the explosion, but it is mixed with others which prevent the explosion from taking place so readily, and which therefore render the use of the *vigorite* less dangerous.

A new construction of such articles as nails, bolts, metallic wires, and other like means of connection and attachment, is introduced by M. Louis Chelot, of Rue Montmartre, Paris. The metallic rods or wires wherefrom these articles are to be manufactured undergo the preliminary operation of being drawn through a grooved drawing-plate parallel to their length; thus the shanks of the finished nails and bolts, &c., present a polygonal and grooved form, with angles of varying sharpness, and grooves of varying depth, according to the object of their use.



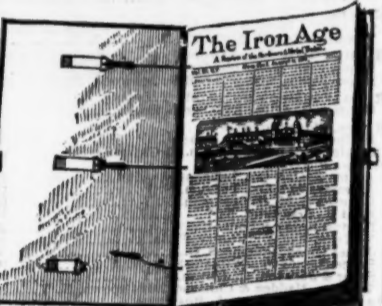
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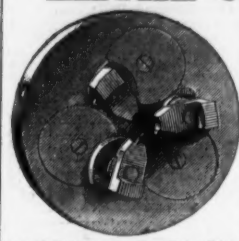
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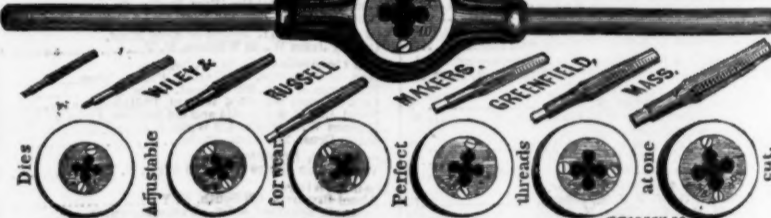
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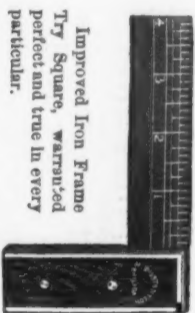
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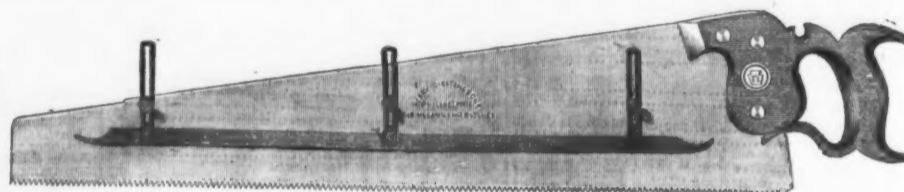
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Patent adjustable Gauge Saw for sawing tenons, kerfing, or any work where the cut is required to be of definite depth. Will pay for itself in one day. Try it and be convinced. Remove the gauge and use as an ordinary saw.



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Is greatly preferred in some sections of the country, and can be easily kept in order if filed according to directions, when so many of the fast-cutting Saws of the present day must lose their shape and cannot be kept in order.
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The Nonpareil, of which the accompanying cut is a representation, is composed of sections of four cutting teeth, each section intersected by a cleaner tooth. It will be observed that the cavities on each side of the cleaner teeth are much larger and deeper than those of the cutting teeth, serving as a receptacle or chamber for dust, and effectually freeing the Saw during the operation of cutting. The cleaner teeth should always be kept shorter or lower than the cutting teeth. (The Gauge, as shown below, is made expressly for this purpose, and by its use the cleaner teeth of any Saw can be regulated and kept of exact length.)
This Saw has given unbounded satisfaction wherever it has been used, and we are constantly receiving orders for the same; in fact, in some sections, and for sawing soft lumber, it is preferred to any other Saw.



DISSTON'S NONPAREIL SAW



Gauge for Regulating Cleaning Teeth.

The cleaning teeth of all saws should be somewhat shorter than the cutting teeth, and, although shortened, they should be of uniform length throughout. The inner edge of the Gauge rests on the points of the cutting teeth, the cleaning teeth projecting through the opening in centre of Gauge. Reduce the projecting points, by means of a file, until arrested by the edges of the Gauge, which is made of hardened steel. Thus tooth after tooth can be rapidly and correctly reduced to an even length by any unskilled operator



Showing the Gauge in Position for Filing the Cleaner Teeth

Wrenches.	
American Adjustable.	dis 45
Master's Adjustable.	dis 20
Diagonal.	dis 20
Collins & Co's.	dis 45
Coca's (genuine).	dis 50
" (Patent).	dis 50
" (Malleable).	dis 50
Lindsay's Patent.	dis 25
Taft's Patent.	dis 25
Davis Patent Duplex.	dis 25
Bemis & Co's Patent Combination.	dis 25
Wringers.	
Providence.	dis 50
Universal-Extra.	dis 50
Novelty.	dis 50
Sherrill.	dis 50
Reliance.	dis 50
Monitor.	dis 50
King.	dis 50
Crowd.	dis 50
Eureka.	dis 50
Independent.	dis 50

TIN WARE AND TRIMMINGS.

STAMPED TIN WARE, dis 5 & 10.	
COMMON STAMPED WARE, & C.	
Bucket Covers.	
Quarts.	dis 5
Half.	dis 5
Per gross.	dis 5
Cake Box Covers.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Cans.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Plates.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Rings.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Caps.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Fittings.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Hangers.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Brackets.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Supports.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Connectors.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Adapters.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Flanges.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Gaskets.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Seals.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Liners.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Insulators.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Shields.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Guards.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Protectors.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Covers.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Caps.	
Small.	dis 5
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Large.	dis 5
Per gross.	dis 5

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Per gross.	dis 5

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Per gross.	dis 5

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Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Supports.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tin Stove Pipe Connectors.	
Small.	dis 5
Medium.	dis 5
Large.	dis 5
Per gross.	dis 5

Tinned.		
No. 1, 5 1/2 inches long.	per gross,	\$4 25
No. 2, 6	do	4 00
No. 3, 6 1/2	do	4 00
No. 4, 7	do	5 00
No. 5, 8	do	5 00
No. 6, 9	do	5 00
Japanned.	per lb.,	1 00
Tinned.	do	1 00
Iron Kettle Bars (F., S. & W.).		dis 45

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WRENCHES,

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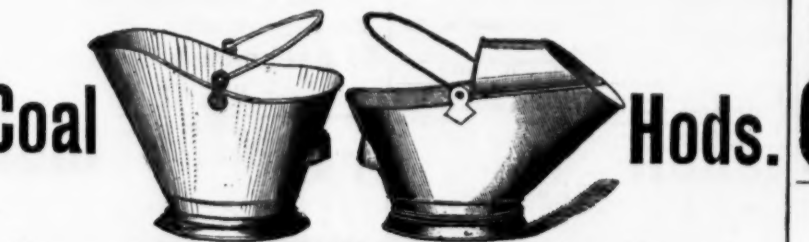
Our Mr. L. Coes, formerly senior member of the firm of L. & A. G. Coes, established in 1839, is the Original Inventor of the Screw Wrench, and has, by making the bar wider, where the strain comes most severe, and screwing a nut up firmly against four square shoulders inside the ferrule, thereby effectually preventing the ferrule from being thrust back into the handle or getting loose, and making a larger screw than in the old wrench, fully succeeded in making a 13 inch wrench stronger than a 15 inch made in the usual manner. All sizes are made in this way, and are undoubtedly the strongest and best finished Screw Wrenches in the market.

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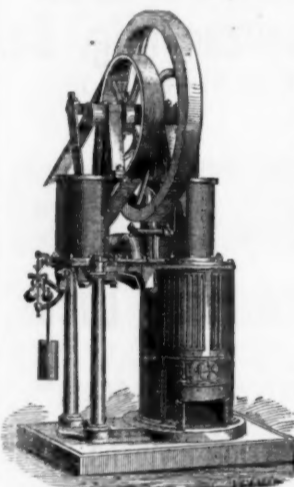
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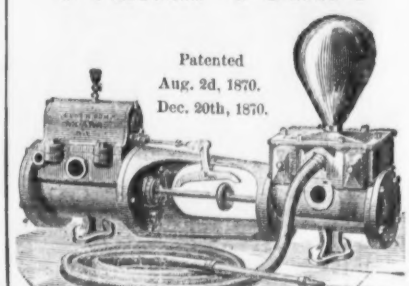
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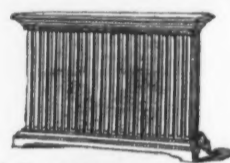
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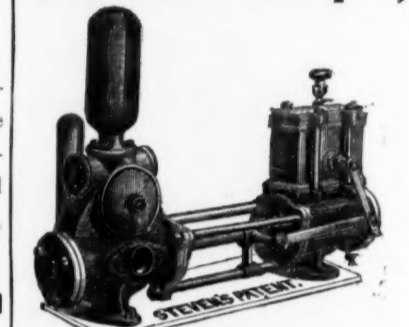
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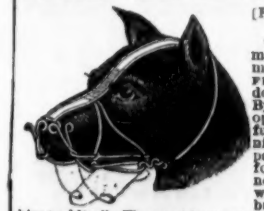
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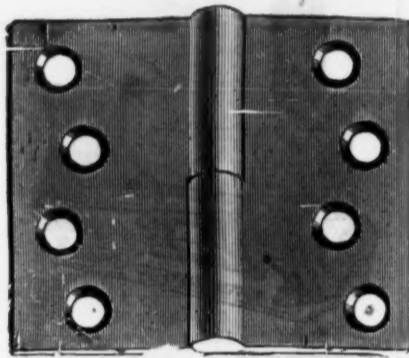
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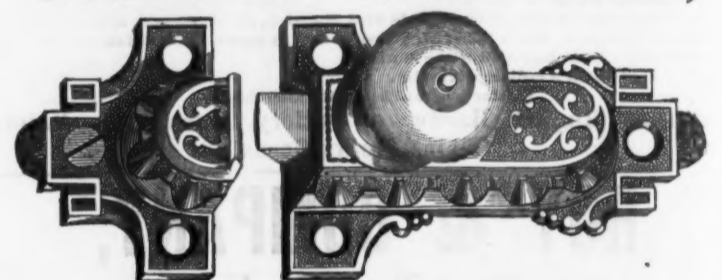
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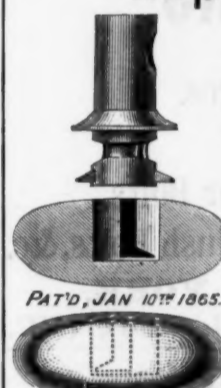
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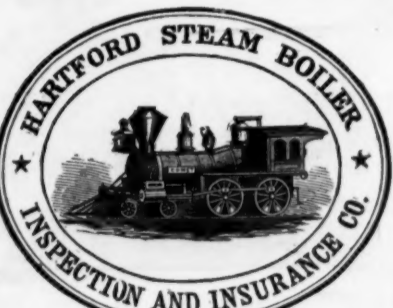
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No. 5. dis 12 1/2
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No. 7. dis 12 1/2
No. 8. dis 12 1/2
No. 9. dis 12 1/2
No. 10. dis 12 1/2

Lippincott, Half Pol.

No. 1. dis 12 1/2
No. 2. dis 12 1/2
No. 3. dis 12 1/2
No. 4. dis 12 1/2
No. 5. dis 12 1/2
No. 6. dis 12 1/2
No. 7. dis 12 1/2
No. 8. dis 12 1/2
No. 9. dis 12 1/2
No. 10. dis 12 1/2

Wrenches-Taft's.

Coe's Imitation. dis 40 1/2
Coe's Genuine. dis 40 1/2
Wrenches-Clayton's. dis 40 1/2
Universal Clothes Winger. dis 40 1/2

Chicago Metal Market.

(Reported by Frank Sturges & Co., 73, 74 & 75 Lake St.)

Tin Plate. dis 12 1/2
10x14, 10x14, 10x14. dis 12 1/2
10x14, 10x14, 10x14. dis 12 1/2
10x14, 10x14, 10x14. dis 12 1/2
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10x14, 10x14, 10x14. dis 12 1/2

BOSTON.

(Reported by Macomber, Bigelow & Dimes, 156 to 164 Oliver St.)

Apple Parers.

Reading. dis 40 1/2
Watrous Ship. dis 40 1/2
L. Hommedien Ship. dis 40 1/2

Axes.

Forester's Favorite, Bronzed. dis 12 1/2
Excelsior, Black. dis 12 1/2
Chopper's Prize, Bronzed. dis 12 1/2
Red Cross, Handled. dis 12 1/2
Boy's Handled Blue Jackets. dis 12 1/2

Axe Handles.

Wadleigh's Oak. dis 12 1/2
A. Extra. dis 12 1/2
Blind Hinges-Washington. dis 12 1/2
Blind Flats. dis 12 1/2
Bolts-Carriage, Phila. dis 12 1/2
Bolts-Best Refined. dis 12 1/2
Bolts-Angle Backs. dis 12 1/2
Boring Machines-Angle. dis 12 1/2
Common, Snell's quality. dis 12 1/2
Brasses-Barber's. dis 12 1/2
Backs. dis 12 1/2
Spofford's. dis 12 1/2

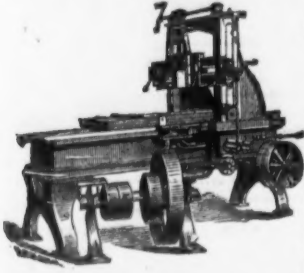
Brass Faucets.

L. F. & C. dis 25 1/2
Butts-Latin Drilled Lath Joint. dis 10 1/2
Wire Fast Joint. dis 10 1/2
Acorn Lath Joint. dis 10 1/2
Wrought Narrow Butts. dis 10 1/2
Wrought Narrow Butts. dis 10 1/2
Cartridges-U. S. Cartridge Co. dis 10 1/2
Chisels-Back Bros. Shank Goods. dis 10 1/2
Sockets. dis 10 1/2
Compasses and Dividers-Bemis'. dis 10 1/2
P. S. & V. dis 10 1/2
Cordage-Manila (usual trade). dis 10 1/2
American Tarred Hemp Lath Yarn. dis 10 1/2
Corn Hooks. dis 10 1/2
Crown Bars-L. F. & C. dis 10 1/2
Sweet Steel Bars. dis 10 1/2
Brown's Steel Bars. dis 10 1/2
S. P. & Co. Extra Iron. dis 10 1/2
Dividers-Cook's Nickel Plated. dis 10 1/2
No. 1, Light inside doors. dis 10 1/2
No. 2, outside. dis 10 1/2
Torry's. dis 10 1/2
Emercy-Alder. dis 10 1/2
Wellington Mills. dis 10 1/2
Files-Earl Smith & Co.'s English. dis 10 1/2
American. dis 10 1/2
Nicholson. dis 10 1/2
Regular Taper. dis 10 1/2
Stubbs' Tapers, genuine. dis 10 1/2
4 1/2, 5 1/2, 6 1/2, 7 1/2, 8 1/2, 9 1/2, 10 1/2, 11 1/2, 12 1/2, 13 1/2, 14 1/2, 15 1/2, 16 1/2, 17 1/2, 18 1/2, 19 1/2, 20 1/2, 21 1/2, 22 1/2, 23 1/2, 24 1/2, 25 1/2, 26 1/2, 27 1/2, 28 1/2, 29 1/2, 30 1/2, 31 1/2, 32 1/2, 33 1/2, 34 1/2, 35 1/2, 36 1/2, 37 1/2, 38 1/2, 39 1/2, 40 1/2, 41 1/2, 42 1/2, 43 1/2, 44 1/2, 45 1/2, 46 1/2, 47 1/2, 48 1/2, 49 1/2, 50 1/2, 51 1/2, 52 1/2, 53 1/2, 54 1/2, 55 1/2, 56 1/2, 57 1/2, 58 1/2, 59 1/2, 60 1/2, 61 1/2, 62 1/2, 63 1/2, 64 1/2, 65 1/2, 66 1/2, 67 1/2, 68 1/2, 69 1/2, 70 1/2, 71 1/2, 72 1/2, 73 1/2, 74 1/2, 75 1/2, 76 1/2, 77 1/2, 78 1/2, 79 1/2, 80 1/2, 81 1/2, 82 1/2, 83 1/2, 84 1/2, 85 1/2, 86 1/2, 87 1/2, 88 1/2, 89 1/2, 90 1/2, 91 1/2, 92 1/2, 93 1/2, 94 1/2, 95 1/2, 96 1/2, 97 1/2, 98 1/2, 99 1/2, 100 1/2, 101 1/2, 102 1/2, 103 1/2, 104 1/2, 105 1/2, 106 1/2, 107 1/2, 108 1/2, 109 1/2, 110 1/2, 111 1/2, 112 1/2, 113 1/2, 114 1/2, 115 1/2, 116 1/2, 117 1/2, 118 1/2, 119 1/2, 120 1/2, 121 1/2, 122 1/2, 123 1/2, 124 1/2, 125 1/2, 126 1/2, 127 1/2, 128 1/2, 129 1/2, 130 1/2, 131 1/2, 132 1/2, 133 1/2, 134 1/2, 135 1/2, 136 1/2, 137 1/2, 138 1/2, 139 1/2, 140 1/2, 141 1/2, 142 1/2, 143 1/2, 144 1/2, 145 1/2, 146 1/2, 147 1/2, 148 1/2, 149 1/2, 150 1/2, 151 1/2, 152 1/2, 153 1/2, 154 1/2, 155 1/2, 156 1/2, 157 1/2, 158 1/2, 159 1/2, 160 1/2, 161 1/2, 162 1/2, 163 1/2, 164 1/2, 165 1/2, 166 1/2, 167 1/2, 168 1/2, 169 1/2, 170 1/2, 171 1/2, 172 1/2, 173 1/2, 174 1/2, 175 1/2, 176 1/2, 177 1/2, 178 1/2, 179 1/2, 180 1/2, 181 1/2, 182 1/2, 183 1/2, 184 1/2, 185 1/2, 186 1/2, 187 1/2, 188 1/2, 189 1/2, 190 1/2, 191 1/2, 192 1/2, 193 1/2, 194 1/2, 195 1/2, 196 1/2, 197 1/2, 198 1/2, 199 1/2, 200 1/2, 201 1/2, 202 1/2, 203 1/2, 204 1/2, 205 1/2, 206 1/2, 207 1/2, 208 1/2, 209 1/2, 210 1/2, 211 1/2, 212 1/2, 213 1/2, 214 1/2, 215 1/2, 216 1/2, 217 1/2, 218 1/2, 219 1/2, 220 1/2, 221 1/2, 222 1/2, 223 1/2, 224 1/2, 225 1/2, 226 1/2, 227 1/2, 228 1/2, 229 1/2, 230 1/2, 231 1/2, 232 1/2, 233 1/2, 234 1/2, 235 1/2, 236 1/2, 237 1/2, 238 1/2, 239 1/2, 240 1/2, 241 1/2, 242 1/2, 243 1/2, 244 1/2, 245 1/2, 246 1/2, 247 1/2, 248 1/2, 249 1/2, 250 1/2, 251 1/2, 252 1/2, 253 1/2, 254 1/2, 255 1/2, 256 1/2, 257 1/2, 258 1/2, 259 1/2, 260 1/2, 261 1/2, 262 1/2, 263 1/2, 264 1/2, 265 1/2, 266 1/2, 267 1/2, 268 1/2, 269 1/2, 270 1/2, 271 1/2, 272 1/2, 273 1/2, 274 1/2, 275 1/2, 276 1/2, 277 1/2, 278 1/2, 279 1/2, 280 1/2, 281 1/2, 282 1/2, 283 1/2, 284 1/2, 285 1/2, 286 1/2, 287 1/2, 288 1/2, 289 1/2, 290 1/2, 291 1/2, 292 1/2, 293 1/2, 294 1/2, 295 1/2, 296 1/2, 297 1/2, 298 1/2, 299 1/2, 300 1/2, 301 1/2, 302 1/2, 303 1/2, 304 1/2, 305 1/2, 306 1/2, 307 1/2, 308 1/2, 309 1/2, 310 1/2, 311 1/2, 312 1/2, 313 1/2, 314 1/2, 315 1/2, 316 1/2, 317 1/2, 318

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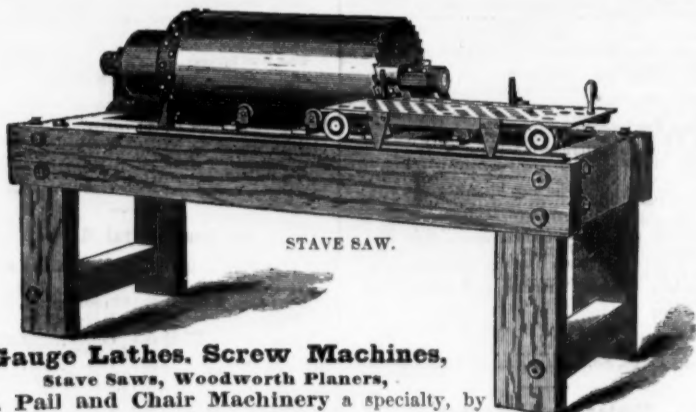
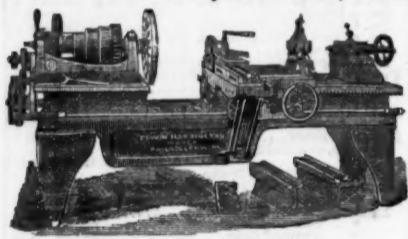
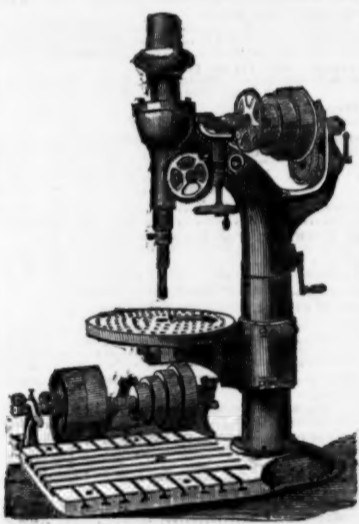
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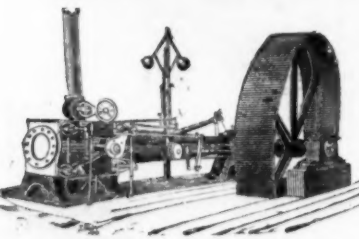
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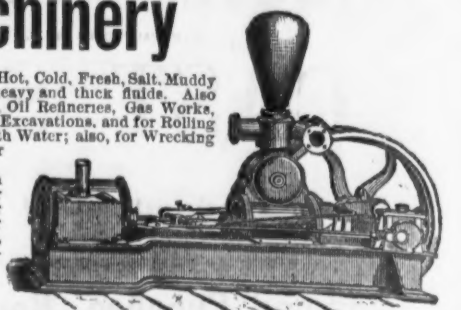
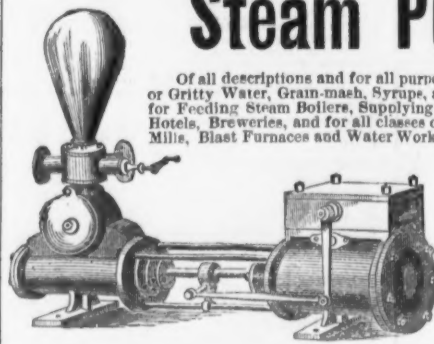
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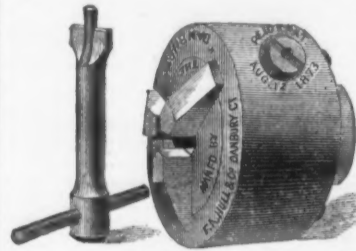
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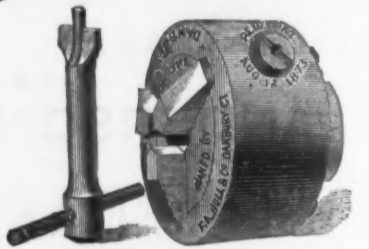


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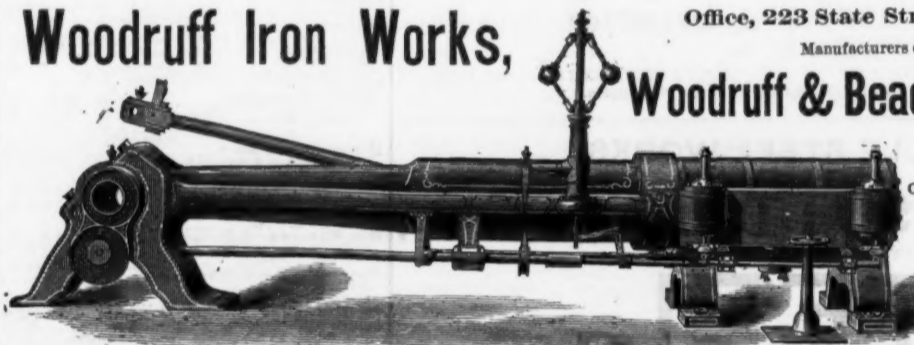
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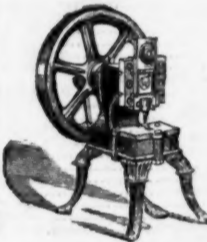
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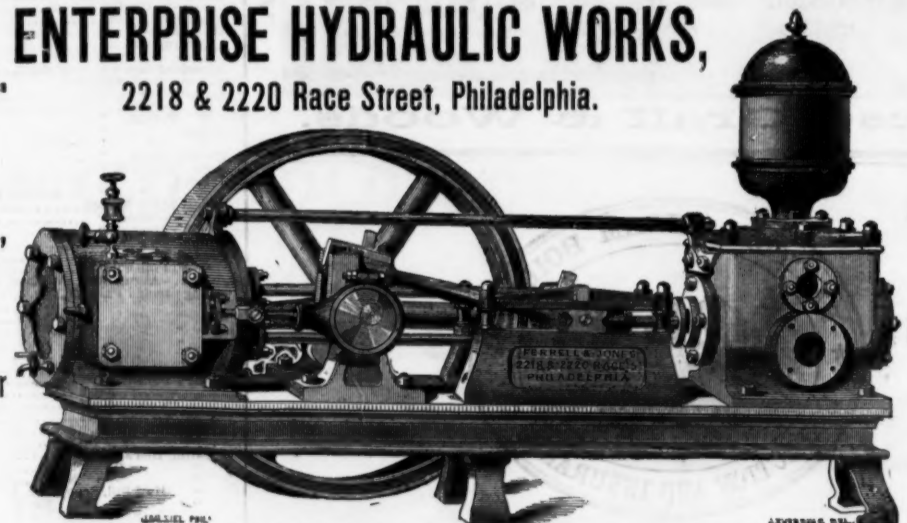
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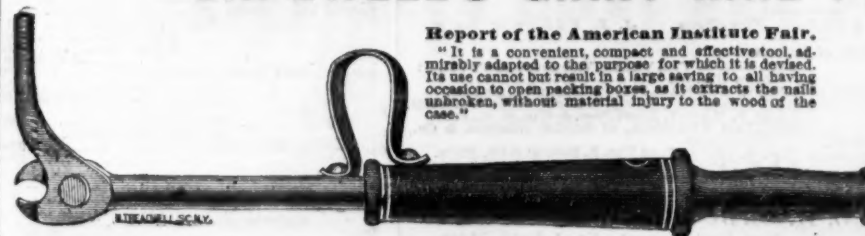
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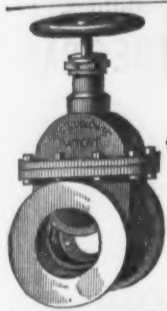
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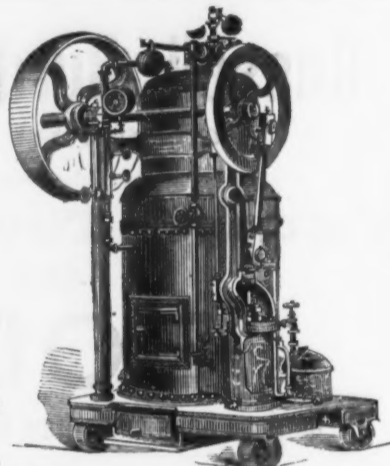
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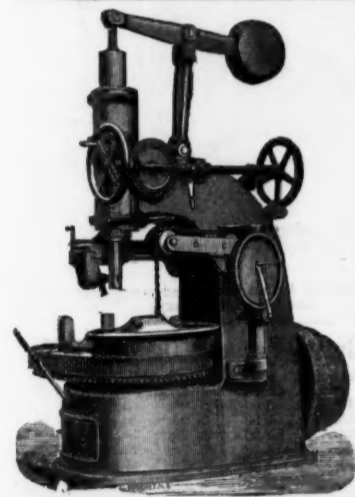
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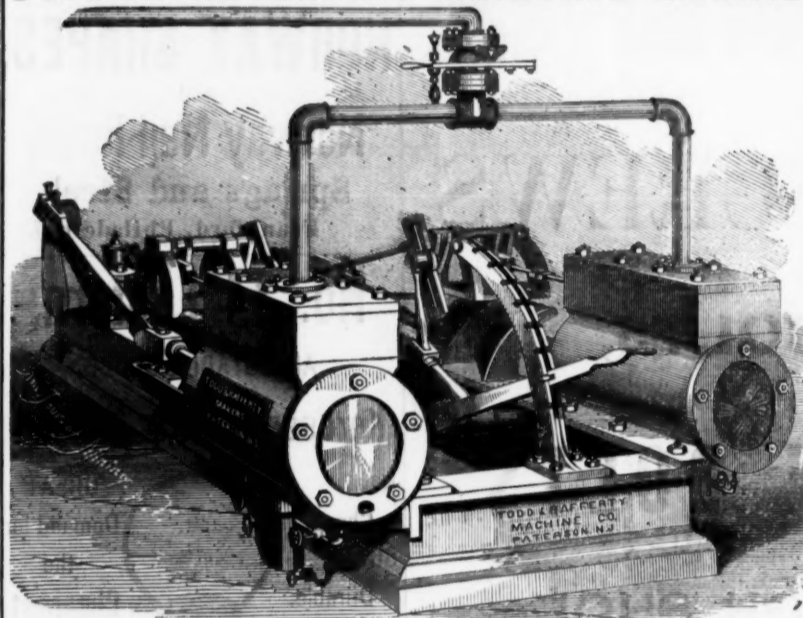
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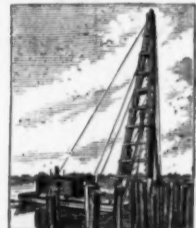
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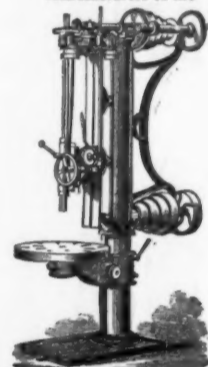
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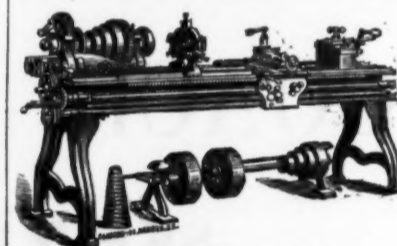
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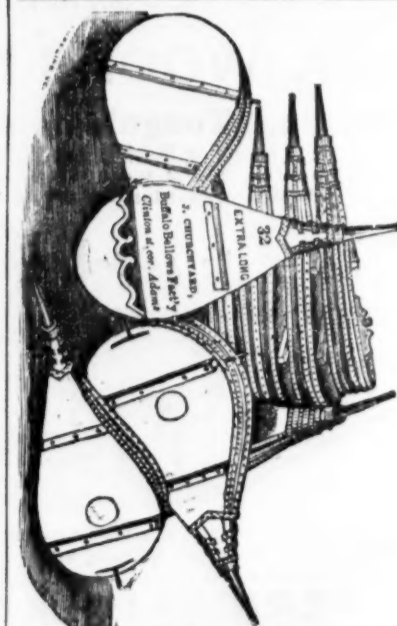
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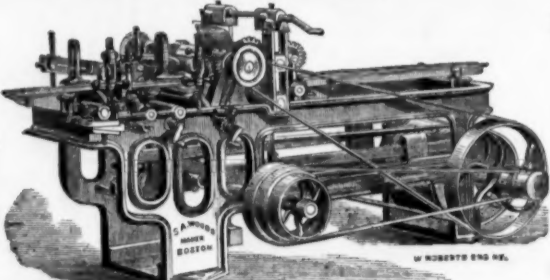
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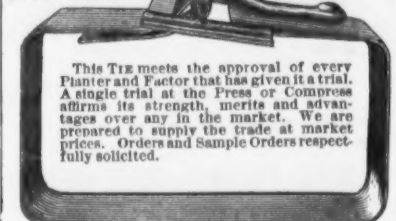
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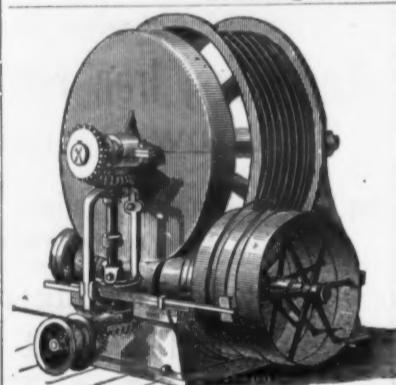


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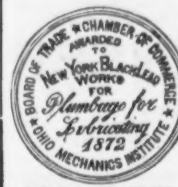


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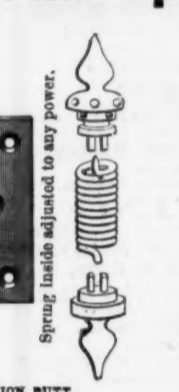
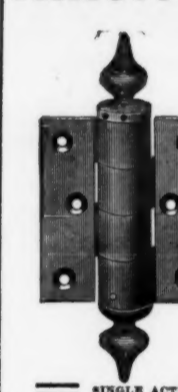
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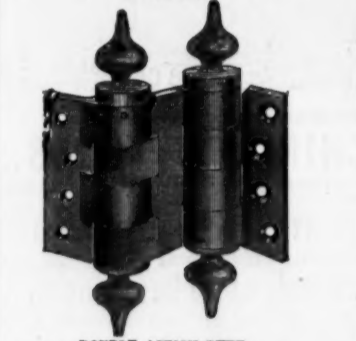
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